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CONTENTS.

EDITORIALS 673
Program for Iowa Electrical Association's Convention.....676
Program for Convention of Iowa Street and Interurban Railway Association 676
Arkansas Association of Public-Utility Operators.....676
Special Train for Jobbers' Convention.....676
Meeting of Cotton Manufacturers.....676
Electrification Only Cure for Smoke Evil.....676
Conference on Standard Electrical Rules.....676
C. A. Adams.....677
The Testing of Transformer Iron.....677
Central-Station Welfare Work.....678
Public Utility Commissions.....678
The Power System of the Southern California Edison Company.—III.—By W. B. Gump.....679
Some Advantages of Combined Pumping and Electric Plants.—By Frank F. Fowle.....685
LETTER TO THE EDITOR.
Carbon-Tetrachloride.—By George Frederick Shaver.....690
Aluminum Transmission Lines.....690
Electric-Vehicle Tires.....690
Underwriters Take Action on Grounded Secondaries.....690
Annual Meeting of American Institute.....690
ELECTRICAL NOTES FROM GREAT BRITAIN.....691
Aluminum Anode Films.....692
Coal Lands and Water-Power Withdrawals.....692
ELECTRICAL NOTES FROM CONTINENTAL EUROPE.....693
Pittsburg Section Meeting.....694
Rebuilding the La Salle Street Tunnel.....695
Elements of Power-Station Design.—XXVIII.—By W. B. Gump.....696
New Electrical Equipment for Panama.....699
Illumination of Denver's Moving-Picture Theaters.—By Joseph A. McMeel 700
Boosting Brooklyn 701
Spectacular Sign for Louisville.....702
Electric Tower Wagon.....702
Electric Street Lighting.—II.—By Albert Scheible.....703
River Wireless Telegraphy.....705
Society of Wireless Telegraph Engineers.....705
Railway Telegraph Superintendents.....705
Signaling on Railways.—By Francis G. Boyd.....705
Telephone Pioneers of America.....707
The Corrosion of Brass and Copper.....707
Range of Wireless Apparatus.....707
Electric Dock Pumping.....708
Electrification of London, Brighton & South Coast Railway.....709
Single-Phase Railway in Lorraine.....710
Proposed Industrial Power Plant.....710
FINANCIAL REPORTS OF ELECTRICAL COMPANIES.....711
NEW ELECTRICAL AND MECHANICAL APPARATUS AND APPLIANCES.....712
CURRENT ELECTRICAL NEWS.....719
PUBLIC SERVICE COMMISSION NEWS.....719
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES 725
RECORD OF ELECTRICAL PATENTS.....727

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SOME SUGGESTIONS FOR SUMMER LOADS.

At this season of the year, with summer and its attendant decreased revenues approaching, the attention of central stations should be directed towards the building of a day load of at least a size sufficient to prevent operating at a loss during the dull season.

In this connection city pumping is an extremely advantageous load to secure. With a properly designed system, pumping can be made the means of filling any valley in the daily load curve and can be profitably taken at a very low rate. A study of existing installations seems to indicate that an induction motor direct-connected to a centrifugal pump is an ideal pumping unit for many classes of service. Another desirable load is that of mechanical refrigeration. Motor-driven compressors for ice plants, in addition to being entirely satisfactory from the manufacturer's standpoint, are the means of building up the night load as well as the day load. By offering a low rate for this business, which, incidently, can be done with profit, arrangement can be made for off-peak operation. Woodworking plants, laundries and other industrial establishments offer a field for the central station which compiles accurate data on comparative installations, to be used as an argument in favor of electric drive.

In view of the noticeable advancement that has been achieved in electric heating and cooking appliances, they undoubtedly offer one of the best fields for summer loads. In winter months electric heating cannot, at present, compete with other methods, when heat has to be used continuously, except at very low rates for current. Between seasons, however, especially in the late spring and early fall, electric heating can be conveniently utilized at a figure that is profitable to the central station.

A brief consideration of the heating and cooking load will reveal that it is essentially an off-peak load. It comes on just as the peak is falling off. For motor business, which cannot be kept entirely off the peak, central stations do not hesitate to make a low rate. In cities where this policy has been inaugurated for heating and cooking business, the results have been very encouraging, even in the face of strong competition from gas companies. It is true that to offer a distinct rate for this business a separate meter would have to be installed, although the flat rate is a possible alternative, but an electric range or a group of household

devices, for instance, can be made just as remunerative as an electric motor, for which the central station is glad to offer a low rate and furnish an extra meter.

MOTOR DRIVES FOR WOOD-BOX FACTORIES.

Among the industries which have been slowest in adopting electric power are the box factories and allied woodworking establishments, which still persist in the time-honored plan of using inefficient steam engines from which power is transmitted to the various machines through a maze of shafting and belts. The excuse for this backwardness has lain in their being able in this way to utilize the sawdust and wood scraps, which waste products may be burnt under their boilers to generate the needed steam. Like many another heritage of the past, this practice has too long been accepted as economical not only by the woodworkers themselves, but often also by the central stations, who have taken it for granted that the abundance of so much scrap wood justified the retention of equipment long outgrown in all other manufacturing lines. In making this assumption, both the central-station men and their possible woodworking customers would seem to have overlooked four important factors:

(1) The saving in space with electric driving, due not only to the elimination of the bulky boiler and engine equipment, but also to the more logical arrangement of the various machines, which no longer need to be located along rigidly parallel lines of shafting, but which can be placed in any spot or position that will lend itself to economical and speedy manipulation. In many cases the saving in the room formerly required for belts and countershafts alone makes quite a difference, allowing dust collectors to be placed more effectively and permitting of better light on the machines. Besides, when any changes are needed, they can easily be made without relocating or disturbing other machines.

(2) The independence of the individual machines, for each of which the electric drive can be adjusted to give the highest speed practicable for the work at hand, thereby greatly increasing the output over what it usually is with the non-adjustable shaft-and-belting transmission.

(3) The ability to start the whole machinery or any part of it on a moment's notice, without waiting to get up a head of steam and without requiring special attendance. Thus one or more machines can be worked overtime without the expense of running the whole power equipment.

(4) Other markets for the refuse. The assumption that these waste products found their highest value as fuel for the plant itself may have been justified ten or twenty years ago, but conditions have changed since that time. Now, instead of being of little use for anything besides fuel, both the wood scraps and the sawdust have a steadily growing market value, the size of which may surprise the average wasteful wood-box maker. If the sale of shavings, sawdust and board scraps only paid for the electric current needed for power, the woodworker would still profit by the first three items above mentioned, plus the wages of his former engineer and fireman. Even as fuel, the continued use of the refuse will rarely be excusable, since a ton of this waste material will usually sell for more than the cost of a ton of low-grade coal, which coal may easily have about double the steam-producing capacity. Had the coal dealers been more alert, they might long ago have persuaded many such woodworkers to buy coal for fuel and to sell their own refuse to others. Now as long as they have not done so, the central station can go a step further by enabling the box maker to throw out his obsolete generating plant altogether, helping him, if necessary, to find a profitable market for the by-products which formerly constituted his fuel. Both sawdust and shavings find a ready market in cold-storage plants, meat markets and stables; also in some localities for vinegar works and alcohol distilleries. Shaved into excelsior, the scraps bring a good price for use as packing or for upholstery; or they may be ground up for use in making certain grades of paper. In some cases, the board scraps have been trimmed to a uniform thickness and are used as a basis for veneered table tops. With a little canvassing of the situation, the alert central-station manager should find a considerable outlet for this refuse and the time spent in placing the same at a profit should be well worth while, for a woodworker once weaned from his old and crude methods of power production will never return to them.

STANDARDIZATION OF HEATING APPARATUS.

Extensive campaigns are being waged by both manufacturers and central-station managers to encourage the use of small household heating devices of every kind. The number of such devices which are available to add comfort and convenience to the home is steadily increasing and in many residences the capacity of the available outlets is seriously taxed. Where a number of such appliances are used in the same room it is of great advantage to be able to switch current quickly and conveniently from one device to another. Unfortunately most of the apparatus seems to be designed without any consideration for the convenience of the user under conditions of this kind.

One enthusiast in the use of household devices is making use of a toaster, coffee percolater, disk stove and two irons, and in addition he has two fans which are sometimes used in the same room. He has called our attention to the fact that every one of these devices must be supplied with a separate attachment cord and plug, since no two of the attachment fittings are interchangeable. Consequently, whenever a change is made from one device to another from the single outlet which is available in his kitchen, it is necessary to unscrew one plug from the socket and replace it with a different one. Not only is there this inconvenience in use, but it is necessary to have quite an assortment of attachment cords available, and as this particular individual considers it necessary

to keep a spare cord in case of burn-out, his number of spares amounts to a half dozen. These conditions apply not only to the apparatus made by different manufacturers for different devices, but also to two devices made by the same manufacturer and to the two irons made by different manufacturers.

It would seem high time that the manufacturers of this kind of apparatus should come to some definite agreement on the type of connection to be used in devices of similar current-consuming capacity and that they should adopt some standard fittings which should be interchangeable. The situation is somewhat similar to that which existed in the early days of incandescent lamps, when it was necessary to have different types of socket for different makes of lamp. Fortunately that has gone by and it cannot be doubted that in time a similar standardization must be reached in other household devices. It will aid manufacturers in popularizing their wares if this standardization is brought about at an early date. The sooner it is done the less expensive will be the change to both manufacturers and users.

TIRES FOR ELECTRIC VEHICLES.

It is perhaps not generally realized that the amount of power necessary to propel a vehicle depends in great measure upon the kind and condition of tires used. A rigid tire is the most economical in energy consumption. Bicycle riders appreciate this fact after having ridden upon a soft tire. Resiliency involves energy consumption, and when comfort, or wear and tear on the vehicle, demands a resilient tire, it is adopted at the expense of efficiency in propulsion.

In electric vehicles one of the problems has been to secure sufficient mileage without undue weight, and the choice of tires has a big influence upon its solution. The current consumption can be reduced by using solid tires rather than pneumatic ones, and hence for the same battery the mileage can be increased. The magnitude of this influence is what challenges the attention of the vehicle user.

In his paper before the Electric Vehicle Association of America, Mr. Dan C. Swander advocates the use of solid tires not only on trucks, but also on pleasure vehicles. Since electric vehicles are used mostly in cities, where smooth paving is generally provided, and since the speeds are usually not excessive, the necessity for pneumatic tires does not exist, and advantage should be taken of the greater economy of operation made possible by the use of the solid tire. Since economy of operation has come to be a talking point with the advocates of the electric vehicle, the choice of tires requires careful consideration. It is to be regretted that more comprehensive data on the subject were not brought forward at the meeting, but the statement was made in the discussion that tests of current consumption had shown differences as great as seventy-five per cent. While it might seem that some other uncontrolled factor had contributed to this excessive figure, the necessity for more extensive tests and the importance of the tire question on economy of operation are both very forcibly emphasized by the possibility of such a statement.

THE TESTING OF TRANSFORMER STEEL.

A comparison of different methods of testing transformer steel has recently been made in England by Mr. Lancelot W. Wild, and his paper on the subject is abstracted in this issue. It consists principally of a comparison of the method used by the Bureau of Standards at Washington with the method of placing the strips in a flat square with interleaved corners, to form the magnetic circuit. Curiously enough, the latter method is assumed to give correct results, providing the corners are rounded off. If the corners are left untrimmed, equivalent results can be obtained by assuming that the part which would be trimmed off carries no flux, a practice not uncommon in this country. An abstract of Mr. Wild's paper will be found on page 677.

One of the principal objections to the method with flat interleaved strips is the non-uniformity of flux which results, since the paths of the tubes of induction are very unequal in length. The flux is crowded more densely in the paths of least length with the result that the losses are *lower* than for uniform distribution. This fact has been mathematically demonstrated by Richter for the case of a circular ring, and applies also to the case of a square. The author apparently is unfamiliar with this, and assumes that an uneven distribution will increase the loss. The fact that the method of the Bureau of Standards gives higher values is consequently in its favor, since it was designed particularly to avoid this very condition. It does not represent the conditions actually found in transformer cores so nearly as the interleaved method, perhaps, but its results probably give a truer value of the real constants of the material.

If the effect of cut edges is to be eliminated by annealing after cutting, so that narrow strips can be used, either method should give accurate results. If such annealing can be carried out, so that any effect of hardening in the corner-pieces of the method of the Bureau of Standards can be eliminated, a real test of this method could be carried out.

It is not at all clear, however, why the observed losses in the various cases vary in the manner stated. Relative differences in the results with sheets of different thicknesses can hardly be explained upon the ground of differences in flux distribution, since it is not obvious why this distribution should depend upon the thickness of the specimen. The differences obtained with different laps in the Washington method are not explained by a hardening of the corner-pieces due to bending, although the author puts forward such a hypothesis. Such an effect would be in the opposite sense. Further investigation seems necessary to explain these results, which do not warrant the conclusions drawn by the author.

Program for Iowa Electrical Association's Convention.

The eleventh annual convention of the Iowa Electrical Association will be held in Davenport, Ia., April 19 and 20, the meetings being held in the Coliseum. An unusually interesting program has been arranged for which includes the following papers: "Waterloo Transmission Records," by Ira L. Craig; "Underground Distribution in Medium Size Cities," by H. B. Gear; "Refrigerating—Its Advantages and Disadvantages," by G. W. Du Mont; "Flat Rates for Small Demand Consumers," by A. H. Ford; "The Electric Automobile," by F. H. Golding; "Methods of Securing and Properly Installing Power Loads," by Harry G. Glass; "Ornamental Curb Illumination," by R. M. Parker; "Industrial Heating Loads," by J. D. A. Cross; and an address by J. W. Samis.

An elaborate entertainment program has been arranged for which includes a smoker on Wednesday evening, and a theater party and rejuvenation of the Sons of Jove on Thursday.

Program for Convention of Iowa Street and Interurban Railway Association.

In conjunction with the convention of the Iowa Electrical Association, the Iowa Street and Interurban Railway Association will hold its annual convention in Davenport, Ia., April 20, 21 and 22. The meetings will be held in the Coliseum. The program includes the following papers:

"The Use of Wood Preservatives—Is the Expense Justified by the Results Obtained," by C. W. Rhodes; "Legislation—The Detrimental Effects of Useless Legislation on Utility Corporations, and the Communities which they Serve;" "Things Worth While in Shop Practice," by Jacob W. Gerke; "Development of the Auxiliary Load for Railway Power Plants," by J. C. Young; "Effective Methods of Handling Snow Storms," by Frank S. Cummings; and "Steel or Steel Tired Wheels vs. Cast Iron," by Engineering Department, Carnegie Steel Company.

The entertainment features provided for the Iowa Electrical Association will be participated in, also, by the Railway Association.

In connection with the two conventions there will be held in the Coliseum a noteworthy exhibit of electrical apparatus and supplies. This is predicted to be one of the largest exhibits maintained in connection with the convention of a state association.

Arkansas Association of Public-Utility Operators.

At a meeting of the executive committee of the Arkansas Association of Public-Utility Operators, held in Little Rock on March 15, it was decided to hold the annual convention at Little Rock on May 3, 4 and 5. Papers will be presented on subjects covering the fields of electric railways, gas, electric lights and water. The convention promises to be one of the largest yet held by this successful organization.

The committee for the entertainment of delegates and guests is composed of D. A. Hegarty, Little Rock Railway and Electric Company, chairman; S. A. Stearns, Arkansas Home Water Company; E. C. Beach, Pulaski Gas Light Company; F. C. Bragg, Electric Construction Company.

Special Train for Jobbers Convention.

A special train, known as the Electrical Supply Jobbers California Limited, will leave Chicago on April 18, for the convention at Del Monte, Cal.

An entertainment committee, of which H. H. Cudmore is chairman, has prepared special song books for the trip, and a piano will be placed in the observation car. There will be card tournaments and an impromptu vaudeville show.

Meeting of Cotton Manufacturers.

The National Association of Cotton Manufacturers will hold its annual meeting at Boston, Mass., on April 12 and 13. Sessions will be held in Huntington Hall, of the Massachusetts Institute of Technology, and papers are promised, among other subjects, on "Power From Producer Gas" and "Standardizing the Artificial Illumination of Cotton Mills."

The annual assessment for members will hereafter be ten dollars and for associate members twenty dollars. The secretary is C. J. H. Woodbury, Box 3672, Boston, Mass.

Modern Science Lecture.

At the meeting of the Modern Science Club, of Brooklyn, N. Y., on April 4, an illustrated lecture on "Shaft Governors" was delivered by Hubert E. Collins.

Electrification Only Cure for Smoke Evil.

The annual report of the department of smoke inspection of the City of Chicago has been completed and is being published. It is a voluminous report, reviewing in particular the work of the year 1910 and in general the work accomplished since the creation of the department four years ago, with Paul P. Bird as chief smoke inspector. From that part of the report that has been made public, the following interesting conclusions are drawn.

In four years the smoke-inspection department, small as it is, has reduced the smoke evil in the city fully one-third. As long as soft coal continues to be used in scattered plants, smoke cannot be reduced below a certain amount. The locomotives of the many steam railroads are the worst offenders, both as to relative amount of smoke produced and soot and cinders thrown broadcast. (This was also shown in Mr. Bird's recent paper on the subject—see ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, February 25, 1911, page 374.) Electrification of the railroad terminals is the only final and satisfactory solution of this phase of the problem. Similarly the electrification of all power and its supply from central stations is the ultimate solution of the isolated-plant smoke problem. Steam boats should burn hard coal. The annual loss directly traceable to smoke-polluted atmosphere is at least $8 per capita per annum and this does not take account of many features, such as illness, esthetics, etc., which are very difficult to estimate in dollars and cents. A more complete summary of this important report will be published as soon as the full report is received.

Conference on Standard Electrical Rules.

The National Conference on Standard Electrical Rules, which was made up of delegates from a number of national societies interested in the subject, was disbanded at a recent meeting held in New York City. As the Underwriters National Electric Association has consolidated with the National Fire Protection Association, and since the latter association has established an electrical committee whose functions will cover the same points as the National Conference, it was felt that there was no further need for the existence of the National Conference.

C. A. Adams.

Among the younger men who have taken a prominent part in the educational side of electrical engineering, the subject of this sketch, Comfort Avery Adams, is well entitled to distinction. Mr. Adams has won renown not only as an instructor but he has contributed greatly to our knowledge of the theory underlying correct design for electrical machinery and his discussion of this subject in papers before technical societies and in the technical press has greatly enlarged our knowledge of the subject.

COMFORT A. ADAMS,
Professor of Electrical Engineering, Harvard University.

Comfort Avery Adams was born in Cleveland, November 1, 1868, the son of Comfort Avery and Catherine Emily (Peticolas) Adams. He received the degree of Bachelor of Science from Case School of Applied Science in Cleveland in 1890, and this institution conferred upon him the degree of Electrical Engineer in 1905. He studied mathematics and physics at Harvard, 1891-1893, and was assistant in physics at the Case School of Applied Science from 1886 to 1890. He applied himself to designing and consulting engineering in 1890 and 1891, was an instructor, 1891 to 1896, assistant professor, 1896 to 1906 and professor of electrical engineering, since 1906, at Harvard University. He has been retained as consulting engineer for many years by a number of prominent corporations, notably with Stone & Webster and with the American Tool & Machine Company.

He was a member of the International Jury of Awards, in the Department of Electricity, at the St. Louis Exposition in 1904. He is a fellow of the Amerman Academy of Arts and Sciences, a member of the American Institute of Electrical Engineers, the Institution of Electrical Engineers of Great Britain, the American Electrochemical Society, Illuminating Engineering Society, the Society for Promotion of Engineering Education, the American Assocation for the Advancement of Science, the Economic Club of Boston, and the Harvard Union Club. He is a prolific writer and the author of several textbooks and a number of special articles on theoretical and practical phases of designing and construction.

The Testing of Transformer Iron.

In the *Journal of the Institution of Electrical Engineers* for February, some results are given by L. W. Wild of the comparison between different methods of testing transformer iron. Three methods were used. In all three the magnetic circuit takes the form of a square. In the first method the strips are built up with butt joints differently disposed in alternate layers, so that the joint in one layer is covered by continuous iron in the next. In the second method the same arrangement is used, except that the square corners are cut in the form of a quadrant so that the cross section is the same at all points of the circuit. The third method employed is that used at the Bureau of Standards in Washington and described in its *Bulletin*, vol. 5, page 453. In this method the strips are made up into four bundles with the larger dimension normal to the plane of the square and at the four corners bent corner-pieces are interleaved with the strips in the bundles.

In each case the strips were 10 by 2 inches in size. The core loss was measured by means of a wattmeter, the energy being supplied from an autotransformer. The potential circuit of the wattmeter was supplied from a separate winding on the specimen. Tests were made at twenty-five and fifty cycles and at flux densities from 2,500 to 15,000 gausses. The weight of iron tested was in every case about four pounds. It is assumed that errors due to wave form, resistance drop, etc., are the same in all three methods. The same strips were as far as possible used in all three methods. With the Washington method two sets of corner-pieces were used, the laps being respectively two and five millimeters. The material tested consisted of two thicknesses of "Lohys" transformer iron and two thicknesses of "Stalloy," a kind of silicon-steel.

With the thicker specimen (0.0199 inch) of Lohys the method with rounded corners and the Washington method gave identical results within one per cent, whereas the interleaved method with square corners was low by about five per cent. This difference between the round and square corners was maintained substantially throughout the tests. With the thinner specimen (0.0146 inch) of Lohys, the Washington and interleaved methods agreed up to 10,000 gausses, above which the Washington method gave the larger losses at both frequencies.

With the Stalloy the Washington method gave higher results in all cases. With the thick Stalloy (0.0199 inch) the difference decreased with increasing flux density, while with the thinner material (0.0139 inch) the difference increased. The difference was in all cases greater with the shorter corner-pieces.

The author assumes that the interleaved method with round corners gives correct results and concludes that the Washington method is unsuitable for Stalloy and that it is of doubtful utility for Lohys. It is unnecessary in the in-

terleaved method to cut the corners round, since it is sufficient to make an allowance for this waste material at the corners. The results will then differ by not more than one per cent from results obtained with round corners. If accurate results are to be obtained the strips must be annealed after being cut, which can be properly done only by the manufacturer. Hence there is no virtue in using wide strips, and dimensions of 10 by 1 inches are recommended.

Central-Station Welfare Work.

The Public Policy Committee of the National Electric Light Association, which during the past winter has been devoting considerable attention to the various aspects of welfare work as related to the central-station industry, held a final meeting at the New York headquarters in the United Engineering Building on March 28, when the report which has been prepared through a series of long conferences, was unanimously adopted, and the recommendations and suggestions were put in definite shape for presentation to the member companies, in number nearly a thousand, at the annual convention in New York next May. The committee has felt the importance of the questions pertaining to the welfare of employees in the central-station industry, and that all notions of philanthropy or charity be entirely eliminated in the suggestion of such relations. Several of the companies already have in force some of the various plans proposed, but it is not assumed that every company will wish to adopt every form of relationship outlined in the report, since wide differences may exist in different communities and companies. The plan includes accident insurance, sickness insurance and death benefits, service annuities, profit sharing, employees' savings and investment funds, and life insurance, although with regard to the last item it is suggested that the companies limit themselves to providing their employees with all possible information in connection with safe low-cost life insurance, and do not put in force any plan of their own.

The report gives in detail the methods by which provision can be made under each of the other heads. By unanimous vote the term "pension" has been dropped, and the service annuity adopted as the recognition of an automatic recompense for continuous service, and the committee is of the opinion that member companies should provide such annuities for every male employee reaching the age of sixty-five and every female employee reaching sixty years, after ten years of continuous and satisfactory service. The details of profit sharing are based upon the idea that it is better to have those engaged in the industry as partners rather than employees, and that preferable profits of the employee based upon his wage scale should reach him in the form of securities of his company and that dividends upon such securities should be paid in cash, in the manner customary with other security holders. Details are also given with regard to savings funds and investment funds, with the object of promoting thrift among employees and, where feasible, combining the plan with profit sharing, it having been found that the two work out very satisfactorily together.

The committee consists of Charles L. Edgar, chairman; Nicholas F. Brady, Charles A. Stone, H. N. Byllesby, Henry L. Doherty, W. W. Freeman, Samuel Insull, Joseph B. McCall, Samuel Scovil, George H. Harries, Everett W. Burdett and Arthur Williams. The committee has had the active co-operation of Thomas E. Murray, president of the Association of Edison Illuminating Companies, W. H. Blood, Jr., and R. S. Hale.

It is believed that it is the first time in the history of the country that an association representing so many corporations, and representing over ninety per cent of the investment and earnings in the industry for which it stands, has taken up such a subject in this comprehensive and thorough-going manner.

Public Utility Commissions.

A general discussion of this subject was participated in by members of the Chicago Electric Club, at the regular meeting of that organization on April 5. The discussion was opened by Alderman Pringle, chairman of the City Council Committee on Oil, Gas and Electricity, who has been instrumental in bringing this question before the state legislature.

Alderman Pringle spoke of the public utility commissions in the states of Wisconsin, New York and Massachusetts, outlining their organization and general scope of work. He said that Illinois could benefit in an indirect way from their experience as each state had to undergo an experience of its own in this particular matter. The speaker referred to the work that has been accomplished and that is at present being done in Chicago in the matter of regulation, emphasizing particularly the practically completed rehabilitation of the street railways. Speaking of the action now being taken in the matter of regulation of gas and telephone rates, Alderman Pringle mentioned the important questions that arise in connection with this—namely, the questions of valuation, depreciation, "going value," etc. The importance of these questions emphasizes, according to the speaker, the need for a permanent commission composed of experts who can deal fairly and intelligently with these phases of regulation. In conclusion Alderman Pringle said that public utility companies should be natural monopolies, regulated by the government.

George Weston, city representative on the Board of Supervising Engineers, Chicago Traction, spoke of the work that has been accomplished by this body. The annual reports issued by the board, showing the excellent results which have been accomplished, the satisfactory way in which questions have been settled and the satisfaction given to both company and public, indictate that this form of regulation commission is eminently satisfactory. He therefore advocates a commission for each class of public utility to be composed of experts in that particular line and include a representative of the companies in its personnel.

Frank F. Fowle said that reasonable regulation must necessarily be mutual. If a company is prohibited from earning profits in excess of what is considered a fair return a compensation should be made to it. A commission should see that a profit is insured by allowing rates to be raised where conditions so warrant. Mr. Fowle spoke briefly of the Wisconsin and New York commissions and recommended, as a result of his observations, a single state commission, for the following reasons: one commission is more economical and efficient than two or more; it is not divided by geographical boundaries; not subject to local political influences; would administer the law without discrimination; would glean a broad experience; and would be able to deal fairly with the smaller companies which operate combination plants.

The Power System of the Southern California Edison Company—III.

The Los Angeles Steam Plant and the Substations.

BY W. B. GUMP.

LOS ANGELES NO. 3 STEAM PLANT.

The steam plant known as "L. A. No. 3," (Fig. 21) is located in Los Angeles, and serves three purposes: a reserve supply of power, a sub-station for local distribution, and a regulating plant for the Kern transmission system. Normally, this plant "floats" in parallel with the Kern transmission line, and the steam-turbine governors are set so that the sudden failure of the transmission system will cause the steam plant to pick up the load immediately.

Edison station No. 3 was put into operation in April, 1904. It contains three steam-turbine units. Two are of the Curtis type, rated at 2,000 kilowatts, three-phase, delivering energy at 2,300 volts, fifty cycles, at 750 revolutions per minute. The third unit is a 6,000 kilowatt Parsons turbine, operating at 16,500 volts, with a speed of 750 revolutions per minute.

The boiler room is composed of a battery of fifteen Stirling water-tube boilers, aggregating 9,257 boiler horsepower. The normal steam pressure is 150 pounds gauge. The steam is superheated about seventy-five degrees.

There are four boiler-feed pumps; two are Snow duplex, size 16 by 10 by 12 inches, and two are Deane, 10 by 6 by 12 inches. A well-water pump, size 6 by 5.75 by 6 inches, is used for transformer cooling water, and also for boiler feed. Two hot-well pumps are installed, one Dowe duplex 8 by 8.5 by 10 inches, and one Worthington duplex 6 by 7.5 by 6 inches.

The condensers are connected to Edwards triplex vacuum pumps, of which there are two. The third air pump is a Blake rotative pump, having mechanically actuated valves.

The fuel-oil pumps are Worthington duplex, size 4.5 by 3.75 by 4 inches. The circulating water for the condensers is supplied by centrifugal pumps. Two of these furnish water at the rate of 7,700 gallons per minute each, being driven by General Electric seventy-five horsepower induction motors, operating at 600 revolutions per minute, at a potential of 2,080 volts. The third centrifugal pump discharges 22,000 gallons per minute, and is direct-connected to a Westinghouse 420-horsepower, 2,300-volt induction motor, operating at a normal speed of 417 revolutions per minute.

The step-bearing pumps are Worthington, size 7.5 by 2 by 6 inches. One gland-water pump is used for the

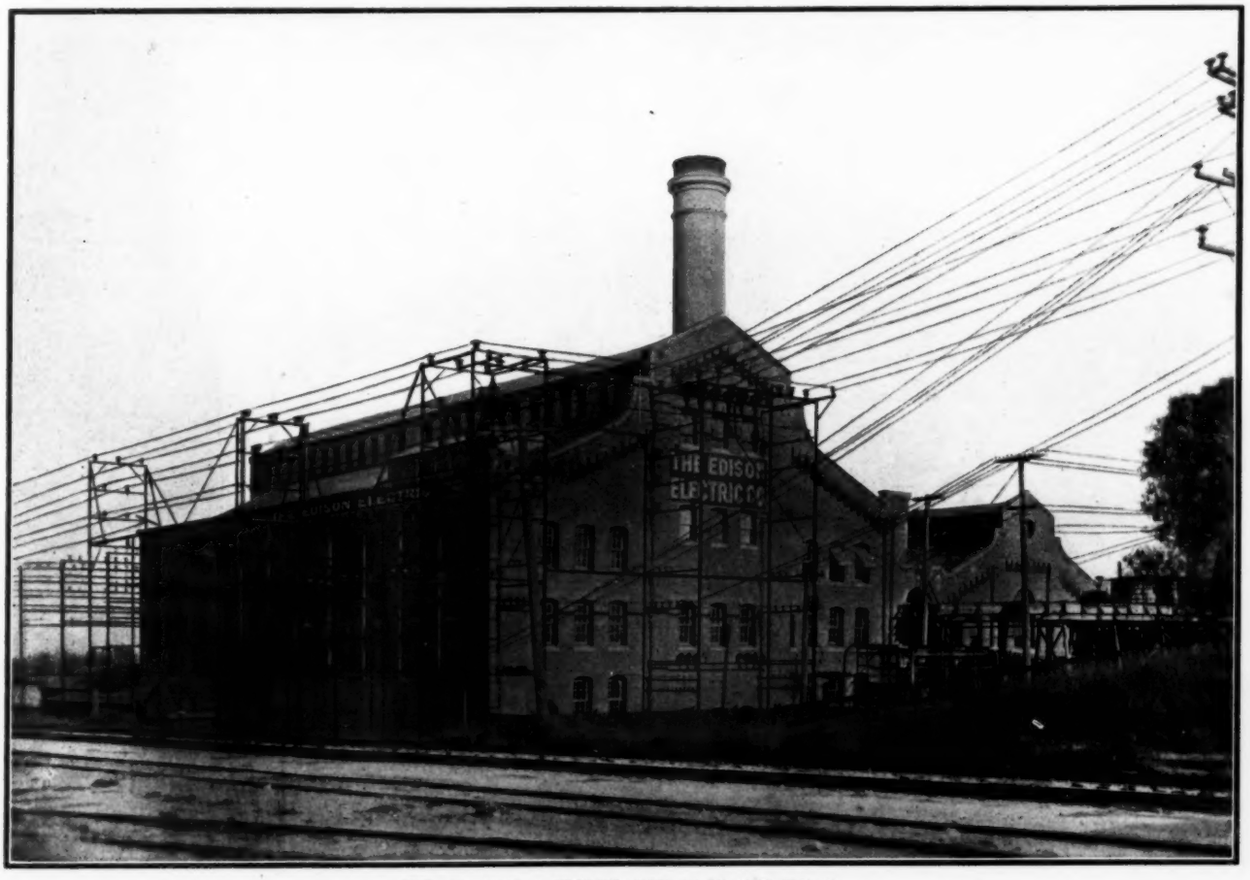


FIG. 21.—LOS ANGELES STEAM PLANT NO. 3.

Westinghouse turbine. This pump is 5 ¼ in. x 3½ in. x 5 in.

There are two feed-water heaters, both of the open type. One is a Cookson 500-horsepower, and the other a Cochrane 6,000-horsepower. The condensers for the vertical turbines are of the Wheeler type, each containing 9,000 square feet of cooling surface. A Worthington condenser of 24,000 square feet surface is a part of the equipment for the Westinghouse turbine.

ELECTRICAL FEATURES.

The main line switches, (Fig 22) are electrically controlled from a central control bench located on a gallery at one end of the station which overlooks the turbine room. The source of energy for operating the switches is received from a ten-kilowatt General Electric motor-generator.

The high-tension wiring is inclosed in concrete compartments, and is supported on porcelain line insulators. The total transformer capacity of this station is 26,700 kilowatts, made up of seven banks of transformers, as follows:

Bank.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Total Capacity	2100 K.W.	2100	4500	4500	4500	4500	4500
Type	W.C.	W.C.	F.O.	F.O.	F.O.	F.O.	F.O.
Primary Volts	60,000 Y.	60,000 Y.	64,000 Y.	64,000 Y.	64,000 Y.	64,000 Y.	64,000 Y.
	30,000 Y.	30,000 Y.	60,000 Y.	60,000 Y.	60,000 Y.	60,000 Y.	32,000 Y.
Secondary Volts	2300	2300	32,000	32,000	32,000	32,000	32,000
			16,000	16,000	16,000	16,000	16,000
Capacity, each Transformer	700 K.W.	700 K.W.	1500 K.W.	1500 K.W.	1500 K.W.	1500 K.W.	1500 K.W.

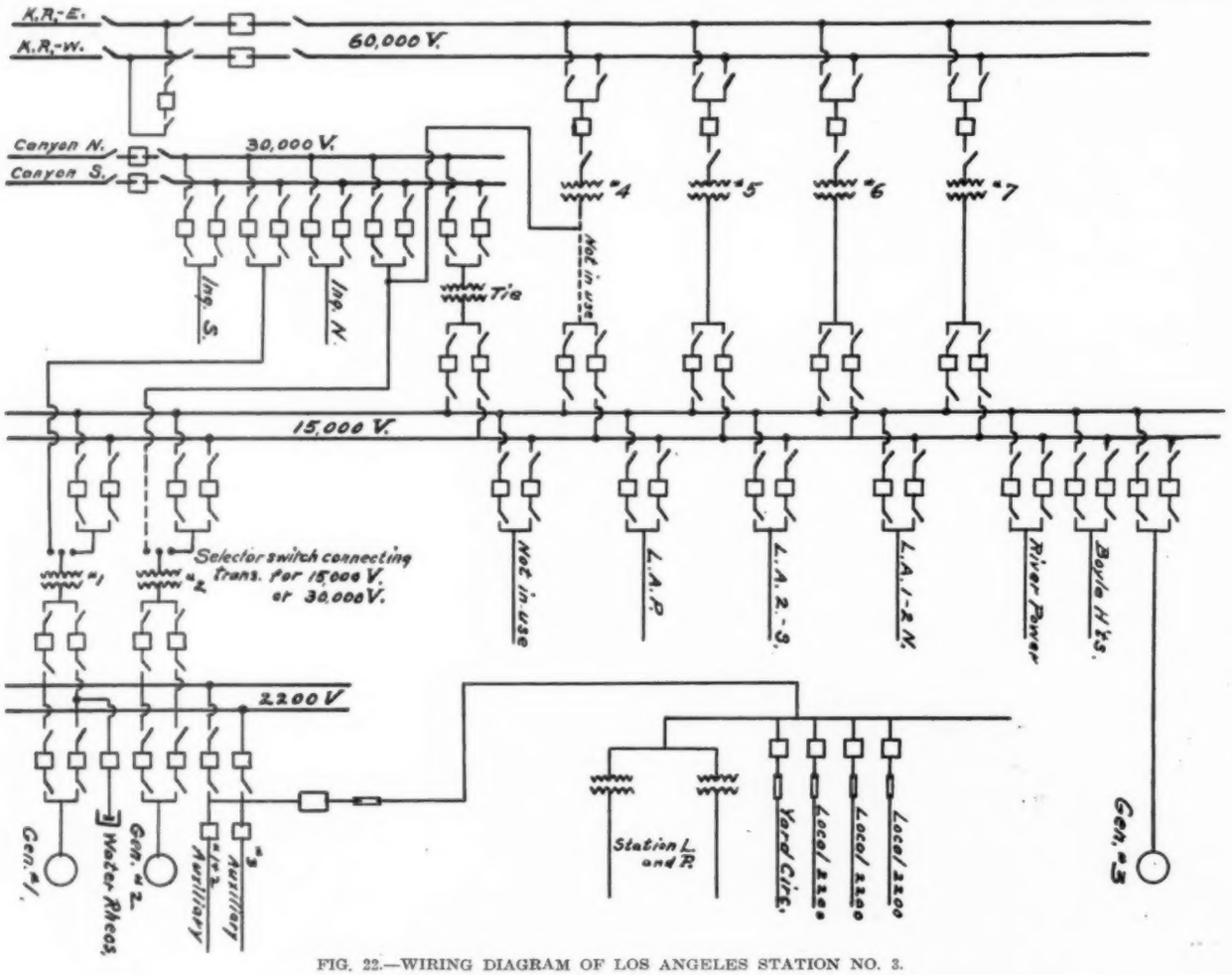


FIG. 22.—WIRING DIAGRAM OF LOS ANGELES STATION NO. 3.

The transformer oil is circulated by means of centrifugal pumps, direct driven by electric motors. The oil is forced to a cooling tower which is constructed of coils over which water trickles, thus absorbing the heat.

Three exciters are installed; two are engine driven, and one is motor-driven. The capacity of each is fifty kilowatts, and generates current at a potential of 125 volts. A General Electric motor-operated air-compressor furnishes compressed air to the station.

The boiler equipment comprises four Edgemore water-tube boilers, each having 1,425 square feet of heating surface. Each boiler is equipped with a Tracy reheating receiver. The prime movers

REDLANDS STEAM PLANT.

This station, (Fig. 23) was originally built for the Home Gas & Electric Company, of Redlands, but was recently purchased by the Southern California Edison Company, and is now used as an emergency plant. This plant was built in 1907, and when first tested it proved to be one of the most efficient, if not the most efficient, steam plant in California. The test showed an economy of 215 kilowatt-hours to the barrel of crude oil, which was considerably ahead of the guarantee.

The boiler equipment comprises four Edgemore water-tube boilers, each having 1,425 square feet of heating surface. Each boiler is equipped with a Tracy reheating receiver. The prime movers consist of two Nordberg tandem-compound, condensing Corliss engines, each 13½ in. x 32 in. x 42 in. operating at

100 revolutions per minute with a steam pressure of 175 pounds. The steam, upon leaving the high-pressure cylinder passes through the reheater before entering the low-pressure cylinder.

There are two Westinghouse three-phase belt-driven generators, each rated at 300 kilowatts, 2,200-volts, running at a speed of 375 revolutions per minute.

The condensers are also belt-driven; the chief purpose being to contribute to high economy. Jet condensers are used. The water circulates to and from a cooling pond. Practically all of the oil from the exhaust steam is eliminated by means of an oil-separator, which is interposed between the low-pressure cylinder and the condenser.

The auxiliaries composing the remainder of the mechanical equipment are as follows:

Two C. H. Wheeler primary feed-water heaters; two C. H. Wheeler secondary feed-water heaters; two Gould triplex oil pumps; two Fairbanks-Morse oil pumps; two auxiliary feed-water pumps; one C. H. Wheeler oil-pump; one Westinghouse air-compressor, and two receivers.

The field current for the generators is supplied from a 12½-kilowatt 125-volt Westinghouse exciter. A duplicate exciter is installed for reserve use.

Current from the generators is transformed to 11,000 volts by means of three Westinghouse transformers, of 150-kilowatts each. The high-tension side is protected by Westinghouse lightning arresters.

SUBSTATIONS.

There are in all twenty-nine substations, including L. A. No. 3 steam plant, which is both a generating and a transforming station.. All of these substations are transformer stations. The one in Los Angeles, which is the largest in the system, also contains motor-generators.

Following is the classification and rating of the transformers:

Bank.	No. 1.	No. 2.	No. 3.	No. 7.	No. 4.
Total Capacity	750 K.W.	750 K.W.	750 K.W.	1155 K.W.	750 K.W.
Type	Air Blast	A.B.	A.B.	A.B.	A.B.
Frequency	50	50	50	50	50
Primary Volts	15,000 Y.	15,000 Y.	17,300 Y.		17,300 Y.
	30,000 Y.	30,000 Y.	30,000 Y.	8,670 Y.	30,000 Y.
Capacity, each	250 K.W.	250 K.W.	250 K.W.	250 K.W.	250 K.W.

The original installation for lighting distribution consisted of the Edison underground or "tube" system. A portion of this installation is still in use, but it is being replaced gradually by the duct system carrying lead-covered cable.

Direct-current power is supplied at 500 volts. A portion of this is for motors operating elevators, printing presses and manufacturing devices.

The rated capacity of the station is 5,155 kilowatts, exclusive of a large storage-battery installation. The wiring diagram shows the general arrangement of operating.

There are seven motor-generator sets, of which five are synchronous, and two are induction-motor driven. These sets are numbered and described in the following:

Set No. 1.—Consists of a General Electric 2,200-volt 300-kilowatt synchronous motor, to which are connected two 150-kilowatt, 140-volt, direct cur-

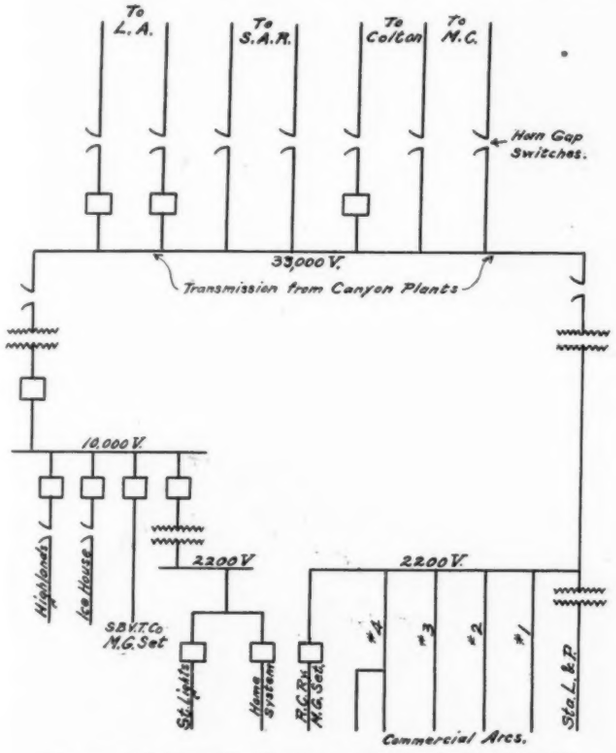


FIG. 23.—WIRING DIAGRAM OF REDLANDS SUBSTATION.

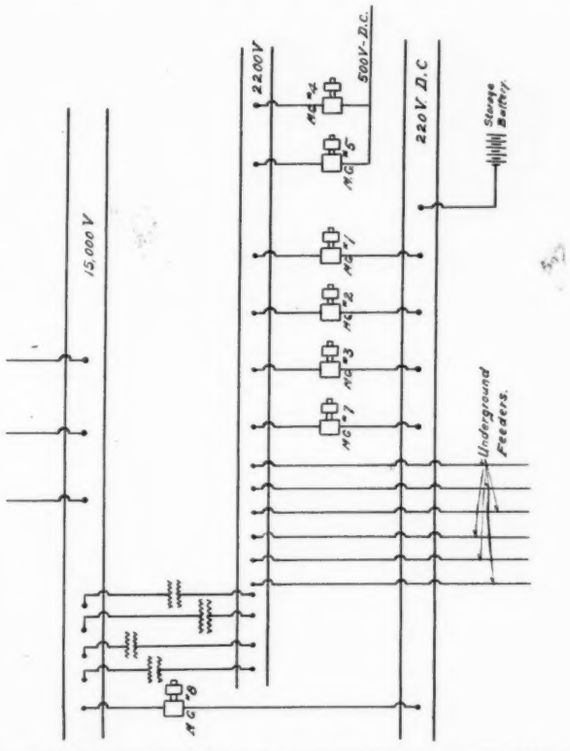


FIG. 24.—WIRING DIAGRAM OF LOS ANGELES NO. 2 SUBSTATION.

LOS ANGELES NO. 2 SUBSTATION.

Los Angeles No. 2 substation (Figs. 24 and 25) receives energy from Los Angeles No. 3 steam plant, at 15,000 volts, and converts it to 2,200 volts, alternating current, and to 220 volts and 500 volts direct current, the latter being used in the underground distributing system. This substation is located directly in the rear of the company's offices on Fourth Street, between Main and Los Angeles Streets.

rent generators, which supply a three-wire lighting system.

Set No. 2.—Is a duplicate of No. 1.

Set No. 3.—Is a General Electric 640-kilowatt, 2,200-volt, synchronous motor, connected to two 300-kilowatt, 140-volt, direct-current generators.

tion has 140 cells, of thirty-three plates each, with a one-hour discharge rate of 1,775 amperes; the other has 140 cells, of eighty-one plates each, having a one-hour discharge rate of 4,200 amperes. This battery floats on the 110-220-volt, three-wire system. The battery was in-

of end-cell switches which are non-automatic, and are electrically operated from the main switchboard.

The motor-generators are started from the direct-current side, and after reaching synchronism are thrown on the alternating-current bus.

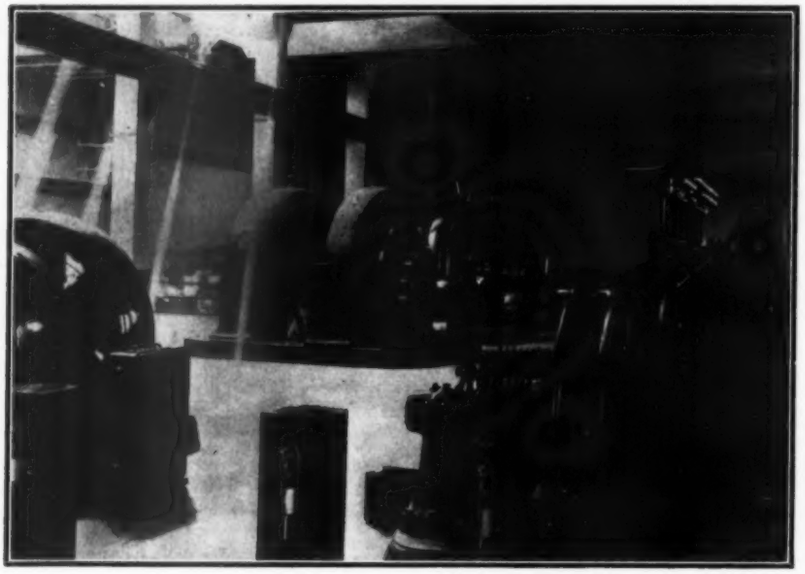


FIG. 25.—LOS ANGELES NO. 2 SUBSTATION.

Set No. 4.—Is an induction motor-generator, the motor being rated at 300 kilowatts, and the generator at 200 kilowatts. The motor is a three-phase, 60-cycle, 2,300-volt, and the generator 525-volt, direct-current.

Set No. 5.—Is an induction motor-generator. The motor is a 450-kilowatt, 2,200-volt, three-phase, fifty-cycle, direct-connected to a 400-kilowatt, 575-volt, direct-current generator.

Set No. 6.—Is a Stanley 1,100-kilowatt, 2,200-volt, fifty-cycle, synchronous motor, connected to a Stanley 1,000-kilowatt, 230-270-volt, direct-current generator.

Set No. 7.—Is an Allis-Chalmers synchronous motor-generator consisting of a 1,000-kilowatt, fifty-cycle, 15,000-volt motor, direct-connected to a 1,000-kilowatt, 250-volt, direct-current generator.

Four voltage regulators are used; three are forty-two-kilowatt, 2,200 volts, 110 amperes each, and the fourth is 2,200 volts, 220 amperes, eighty kilowatts.

STORAGE BATTERY.

A storage battery works in conjunction with this station, consisting of 280 cells, of type H, Chloride Accumulator. This battery is in two groups. One sec-

stalled for emergency service entirely. It is connected to the system without a booster.

Voltage control is effected by means

LONG BEACH SUBSTATION.

The substation at Long Beach, (Fig. 26) is the largest of the transformer substations. It is used as a distributing station which receives energy at 33,000 volts, transforming to 10,000 volts for San Pedro, Terminal Island, and Dredger power circuits.

There are three constant-current arc transformers, of thirty-kilowatt capacity each, and one of forty-five-kilowatt capacity. The three are air-cooled, and the last named is of the oil-cooled type.

Air is supplied to the air-blast transformers by means of a five-horsepower induction motor, belted to a Buffalo blower.

It is not practicable to attempt to describe the remaining substations, since they contain only the standard apparatus which is required for ordinary three-phase transformation.

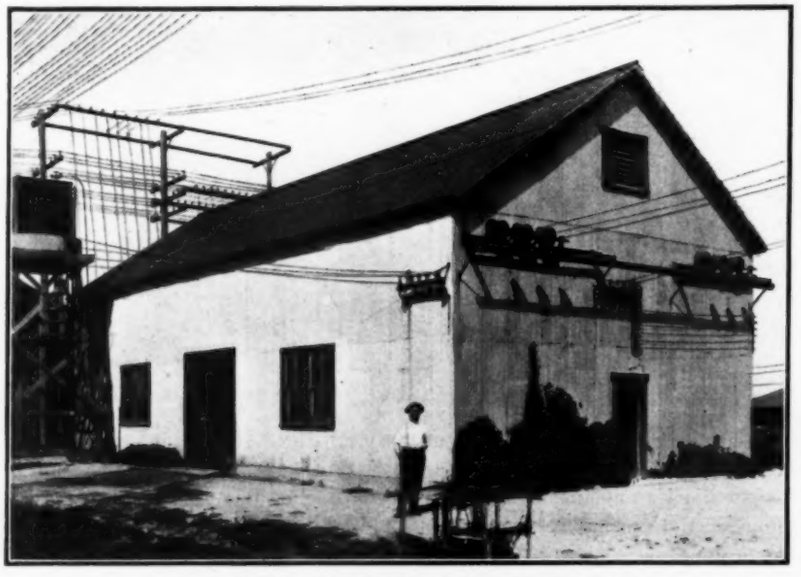


FIG. 26.—LONG BEACH TRANSFORMER SUBSTATION.

Figs. 27 and 28 represent typical substations. The substations already described represent characteristic features of the system as a whole, and the tabu-

TRANSFORMER BANKS IN THE LONG BEACH SUBSTATION.

Bank.	No. 1.	No. 2.	No. 3.	No. 4.
Total Capacity	600 K.W.	600 K.W.	1200 K.V.A.	1500 K.W.
Type	A.B.	W.C.	W.C.	W.C.
Frequency	50	50	50	50
Primary Volts.	11,000	30,000 Y. 15,000 Y.	30,000 33,000	15,000 Y. 30,000
Secondary Volts	2,500	10,000	2,400	11,000
Capacity of each	200 K.W.	200 K.W.	400 K.V.A.	500 K.W.

lated list of substations, giving the capacity of each, is given herein, so that the description may be sufficiently complete for all practical purposes.

Most of these substations contain water-cooled transformers, the cooling water being circulated over a cooling tower by means of an induction-motor-driven centrifugal pump. An arrangement is made in the way of a tank containing a ball float, which in case of failure of the centrifugal pump, allows the city water to be circulated through the transformers.

LIST OF TRANSFORMER STATIONS.

	Total Capacity.	Series Trans Arc Capac.
	K.W.	
Pomona	450	65
L. A. No. 1	2,025	...
L. A. No. 2	5,155	...
University Sub.	2,475	...
San Pedro St.	2,250	...
River Power	1,200	...
San Fernando	1,200	...
Redlands	2,340	...
Redlands Junc.	30	...
Highlands	75	...
Pasadena	3,000	...
Monrovia	300	...
Castaic	2,100	...
Colton	3,600	...
Claremont	75	...
San Dimas	50	...
Lordsburg	50	...
Puente	450	...
Santa Ana	1,950	65
Orange	150	...
Long Beach	3,900	300
Santa Monica	600	290
Ocean Park	1,950	...
Sawtelle	300	...
Whittier	225	37
Fullerton	3,150	...
San Pedro	300	122
Inglewood	1,300	...
Redondo	300	75

It is interesting to note that in this system none of the manholes or transformer vaults have sewer connections. They are kept perfectly dry even in the most severe rain storms, by employing double covers, the inner being made water-tight by tamping cotton rope around a groove made by the edge of the cover when in place. The rope used is first impregnated with paraffine to insure proof against moisture.

The outer cover is composed of two halves, rectangular in shape, which fit snugly into a cover plate but are not water-tight.

Manholes are sealed, and no ventilation is provided other than that which can take place through the ducts.

Transformer vaults are ventilated by having two iron pipes extending from the vault to the curb. One of these pipes connects to the lower portion of the vault, near the floor, while the other terminates above. In this way air circulates through the vault, cold air entering below and passing out above.

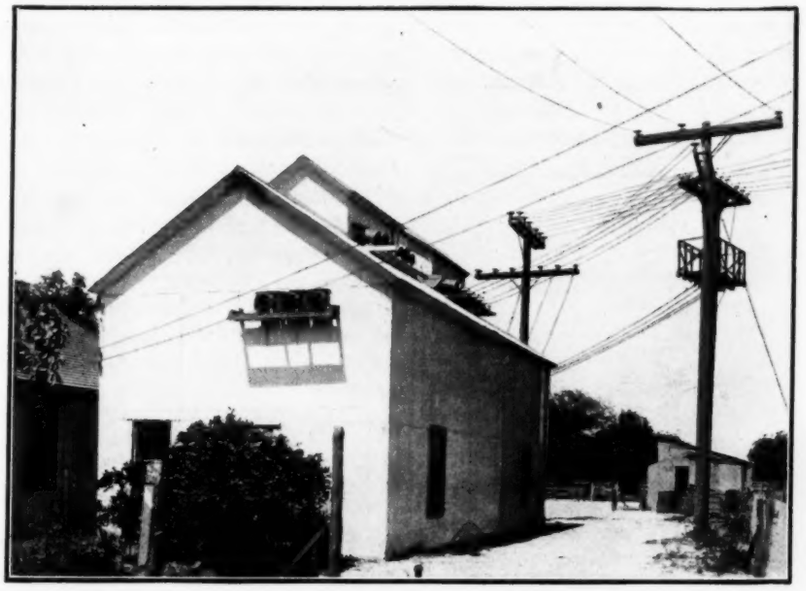


FIG. 28.—PUENTE SWITCHING STATION.

FIG. 27.—PASADENA SUBSTATION.

THE UNDERGROUND SYSTEM.

The underground system extends throughout the business district of Los Angeles, supplying both lighting (Fig. 29) and power. The conduits are constructed of fiber laid in cement. The manholes and transformer vaults are of brick and concrete.

Up to the present time the vaults and manholes have been constructed with brick sides, and concrete floors and tops. The outside of the walls is plastered with cement mortar to make them impervious to water.

At present there are 410 manholes and forty-nine transformer vaults.

The average distance between manholes is 125 feet, thereby affording convenient points for distribution to buildings. Instead of carrying the wiring from the manholes in iron conduits, it has been found more profitable to employ a fiber conduit of special construction, known as "indurated fiber," which is moisture proof, as well as acid proof, and will not rust out, as is often the case with iron pipe. Where this fiber is laid in the street or extends in a vertical position, it is protected by a wood boxing, so that workmen having occasion to dig near this material cannot readily cut into it.

The alternating-current primary cables are three-conductor, 2,200-volts, paper-insulated, and lead-covered.

All of the manholes and transformer

vaults are inspected weekly, so that impending trouble may be readily detected, and breakdowns averted.

There is installed about 90,000 feet of Edison tube; 39,000 feet of conduit ranging from one to forty-six duct, and 380,000 feet of cable of various sizes, the largest being 700,000 circular mils. The manholes are located at street intersections and other convenient points.

NEW STEAM PLANT OF THE SOUTHERN CALIFORNIA EDISON COMPANY.

The site of the new steam plant which the Southern California Edison

FIG. 29—STREET-LIGHTING POST, LOS ANGELES.

company is building is in the city of Long Beach, California, and comprises about ten acres adjacent to the entrance to what is known as the Inner Harbor. This site was chosen on account of its favorable location with respect to the ocean, it being imperative that the plant should be located where there would be ample quantity of water for use in condensing purposes.

This steam station will comprise two buildings having a combined floor space of nearly an acre. The generator and boiler house will have a floor area of 30,000 square feet and will be sixty feet high, while the building which will contain the electrical switches and transformers will cover 7,600 square feet and will be four stories in height. These buildings when finished, will present a handsome appearance. Both structures are to be of reinforced concrete with artificial stone base, ornamental copper cornice and mission tile roof. The generator room will have a floor of imported Welsh quarry tile, with a glazed tile wainscot. Everything considered, this will be the most handsome and best equipped steam plant west of Chicago.

The main unit will consist of a steam turbine of 12,000 kilowatts capacity.

For supplying steam to this turbine, there will be eight 750 horse-power Stirling boilers. These will be capable of evaporating 2,880 tons of water a day, an amount equal to that contained

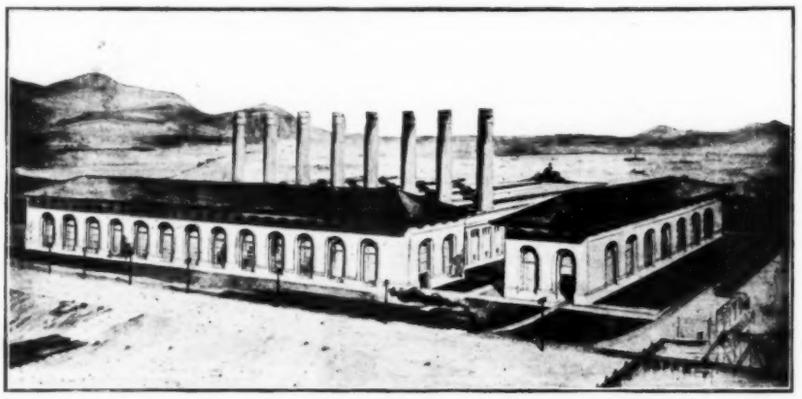


FIG. 30.—NEW STEAM GENERATING STATION AT LONG BEACH.

in an eight-inch water main fifty miles long.

Crude oil will be used for fuel, large concrete supply tanks being located at the west end of the property. This oil will be shipped in tank cars or may be pumped through a main which now runs by the company's property. The eight boilers will consume four carloads of oil per day.

The steam, after passing through the turbine, is condensed and returned to the boilers. In order to condense this steam, cold salt water from the ocean is pumped through a large condenser consisting of an immense cast-iron shell containing over nineteen miles of brass tubing.

Although only one unit will be installed at the present time, the buildings are being built of ample size for two large machines with their boilers and auxiliaries. The property on which the plant is located will allow for future growth, and the company can ultimately extend the station so that it will be the largest of its kind in the West.

Fredrick Sargent of Chicago has been retained as consulting mechanical engineer. The Southern California Edison Company's engineering department is survising the construction work and has made all of the designs and plans except the purely architectural details which were designed by Parkinson & Bergstrom, who have been retained as consulting architects.

PERSONNEL OF PRESENT ORGANIZATION.

In concluding this description, mention should be made of the present management under which the Southern California Edison Company operates. The executive offices of the company are located in Los Angeles, on Fourth Street, between Main and Los Angeles Streets. Here the heads of various departments supervise the work connected with the administration.

Officers of the company are as follows:

J. B. Miller, president.

W. A. Brackenridge, vice-president and general manager.

R. H. Ballard, secretary and assistant general manager.

W. L. Percey, treasurer.

J. A. Lighthipe, electrical engineer.

B. F. Pearson, general superintendent.

S. M. Kennedy, general agent.

H. W. Dennis is construction engineer and is now in charge of the steam power development at Long Beach.

The streets of Chicago are illuminated at night with more and larger electric signs than any other city.

SOME ADVANTAGES OF COMBINED PUMPING AND ELECTRIC PLANTS.

BY FRANK F. FOWLE.

The most obvious economies which result from combining two or more public utilities operating in the same territory are the reduction of administrative expense and the common use of property or plant. Such consolidations have the greatest potential advantage, probably, when the properties united are comparatively small. Public utility companies furnishing water, gas, heating, lighting, power and traction service, or some combination of these kinds of service, are frequently found in the medium-sized and smaller cities throughout the country. It is not uncommon, either, to find municipalities engaged in furnishing two or more kinds of such service, with the general exception of traction service. At the same time it is somewhat unusual to find such combined utilities operated in as economical a manner as would be possible if the entire properties could be built anew at the present time, without the necessity of utilizing partly worn-out but still useful plant.

In reviewing the conditions which led up to many situations as they now exist, it may be observed that the business of supplying water or gas for public consumption is much older than the other forms of service mentioned and plants for that purpose were built long before the uses for electric energy were known or thought about, and long before the operation or management of public utilities commenced to approach the scientific plane it now occupies. In other words, each utility was usually designed, constructed and operated as a separate property. But the last two decades have been distinguished by the great commercial expansion and development of the electrical industry, as a whole, including, of course, the wonderful development in the business of supplying electrical energy for public service or consumption in its numerous forms. At the same time the older utilities have been expanding, as well, but the credit for this growth belongs very largely to electrical engineers, either through direct participation or through the stimulating influence of competition. They have been foremost in studying the nature and variations of public demand and in the matters of scientific design and operation to meet such demands most economically.

Contemporaneously there has been a rapid expansion in the corporate method of conducting business, because of the necessity for combining the capital resources of individuals to carry through large undertakings and the advantages of limited liability. There has long been a tendency in corporate development to unite similar industries, in order to acquire the stability in a business sense which accompanies large enterprises and to acquire capital on more favorable terms. It is but natural, therefore, that public utility enterprises should be consolidated in many instances because of their generally similar character, without regard to the nature of the service in detail. This is the undoubted tendency under the corporate method of transacting business.

But we have passed the period, in many instances, where the direct advantages of consolidation are of immediate or potential value and we are now entering a period in which science in operation and management is especially prominent. Electrical engineers are particularly fitted for this work, because electrical development as a whole has been marked by a greater application and use of science than any other modern engineering development. One of the specific problems now before us is how to operate different public utilities on a mutual basis with the greatest economy and conservation of natural resources. As a whole this problem is exceedingly broad and has many aspects; it is a subject of tremendous scope and full of possibilities that now, in all probability, we fail to recognize. The progress along these lines will almost certainly be one of gradual development and seemingly slow application; we cannot, for obvious financial reasons, at once abandon plants that suddenly become obsolete because of progress in the arts, but we can always be shaping our policies toward the most desirable ends.

One of the prevalent types of consolidated utility plants is that which furnishes water, gas and electric service, and it supplies some very interesting problems along the lines which have just been mentioned. The use of primary sources of power is confined largely, in such properties, to the water and electric departments; and possible means of improving the economy in power production and application in these departments form the specific consideration in this article. Combined water and electric utilities, under private or municipal ownership, are divisible for present considerations into two groups, one of which represents the consolidation of separate properties and the other those properties which are joint from the start. The problems of power economy in these two cases are broadly alike, but different in their immediate aspect. In the first case it is sometimes necessary, for financial reasons, to retain obsolete equipment until the progress of physical depreciation has nearly run its course; in consequence it is often impossible to apply the most economical methods at once, but instead gradually, as parts of the property arrive at the ends of their usefulness or economical lives. In the second case, on the other hand, the field is clear at the start for the application of the most economical methods, in design and operation, that are known at the moment. These considerations arise in every specific case, naturally, but they affect the application rather than the solution of economic problems.

The economies in administrative and executive expense which result from consolidation are matters of organization, rather than engineering, in the narrow sense. The joint or common use of plant, however, is entirely within the province of engineering and presents the topic hereafter considered. The generation and utilization of primary power forms a basic consideration in furnishing both electrical energy and water for public consumption. In considering the probable fields for joint use or occupancy, the respective distribution systems may be dismissed at once on account of their fundamental differences; and the question of primary sources of water supply can also be eliminated. The problem is confined for the most part to land, buildings and power plant. Economy of land can be effected in the matter of pipe and pole yards, possibly in the matter of sidetrack facilities and fuel storage, and again in ground space for buildings. The joint use of power facilities, however, raises the problems of most interest. If the power plants can be con-

solidated at one location there is obviously some economy in investment for a single joint building as compared with separate buildings.

The joint use of primary power sources, however, raises entirely separate questions. The natural starting point on this side of the problem is a study of the public demands for water and electric service, including the variations hourly, daily, weekly, monthly and annually. By following this course it will be possible to determine to what extent the demands are simultaneous and to what extent diverse. The probable existence of a diversity factor between the two kinds of service suggests certain important economies at once. The following table has been prepared from monthly statistics of output from a pumping station and an electric station, each supplying the entire demands in a city of less than 20,000 inhabitants. Column 1 of the table gives the monthly outputs of water in percentages of the annual output and column 2 gives similar data for the electric output. Column 3 gives the monthly outputs on the assumption of a constant rate per day throughout the year

TABLE I.—MONTHLY OUTPUTS OF WATER AND ELECTRIC ENERGY IN PERCENTAGES OF ANNUAL OUTPUTS; AND MONTHLY PERCENTAGES OF ANNUAL PEAK LOAD.

	—Output by— months.			—Deviation— in output.		
	Water (1).	Electric (2).	Uniform Rate (3).	Water (4).	Electric (5).	Monthly Electric Peak Load (6).
January	8.68	9.17	8.49	+0.19	+0.68	83
February	7.39	8.25	7.67	—0.28	+0.58	77
March	8.43	8.55	8.49	—0.06	+0.06	72
April	7.14	8.12	8.22	—1.08	—0.10	68
May	7.17	7.07	8.49	—1.32	—1.42	68
June	8.76	6.77	8.22	+0.54	—1.45	66
July	10.81	6.57	8.49	+2.32	—1.92	65
August	9.50	7.14	8.49	+1.01	—1.35	67
September	8.69	7.76	8.22	+0.47	—0.46	69
October	8.41	9.09	8.49	—0.08	+0.60	81
November	7.10	10.35	8.22	—1.12	+2.13	97
December	8.03	11.18	8.49	—0.46	+2.69	100

and serves as a basis for comparison with the actual outputs. Column 4 gives the deviation of the percentages in column 1, for water, from those in column 3; or, in other words, it shows the monthly variation from a uniform rate of output. Column 5 shows the same thing for the electric output. The annual peak load on the electric station came in December and column 6 shows how the monthly peak loads compare with the annual peak, in per cent.

The annual peak of demand for water came in July, as compared with December for electricity; the lowest demand for water came in May, while the lowest peak demand for electricity came in July. In general the demand for electricity increased from July to December and fell from January to June, while the demand for water varied in the reverse manner, although there was some irregularity in April and May, followed by a rapid rise in June and July. The explanation of these conditions is almost obvious; the long lighting hours occur, of course, during the early winter season and the greatest demands for water, caused largely by sprinkling, occur during the summer. The demands for both kinds of service, however, are affected by weather conditions; if the summer rainfalls are heavy, the demands for sprinkling are correspondingly lessened. Dark weather, at any time of year, increases the lighting demands. These factors are rarely alike in consecutive years and in fact may not repeat themselves for a period of several or even many years. Table II. shows statistics of output similar to Table I., for the same city, during the year next preceding. The variations of electric output and demand are quite similar to those in Table I., as might be expected from the fact that the variation in the length of a day (sunrise to sunset), during a whole year, is largely responsible for the variations of load. The maximum demand for water occurred in July and the minimum in February, with a very consistent change, month by month, from one extreme to the other. The year, as a whole, seems to show very normal conditions, quite consistent with the ordinary fluctuations of output and demand.

TABLE II.—MONTHLY OUTPUTS IN PER CENT FOR THE YEAR PRECEDING THE PERIOD OF TABLE I.

	—Output by— months.			—Deviation— in output.		
	Water	Electric	Uniform Rate	Water	Electric	Electric Peak Load
January	7.58	8.77	8.49	—0.91	+0.28	69
February	6.83	8.32	7.57	—0.84	+0.65	60
March	7.41	7.77	8.49	—1.08	—0.72	66
April	7.12	7.35	8.22	—1.10	—0.87	62
May	7.09	7.15	8.49	—1.40	—1.34	62
June	8.04	6.58	8.22	—0.18	—1.64	59
July	9.85	6.78	8.49	+1.36	—1.71	60
August	10.54	7.36	8.49	+2.05	—1.13	69
September	10.20	7.95	8.22	+1.98	—0.27	79
October	8.65	10.21	8.49	+0.16	+1.72	85
November	8.19	10.26	8.22	—0.03	+2.04	97
December	8.54	11.45	8.49	+0.05	+2.96	100

TABLE III.—MONTHLY OUTPUTS IN PER CENT FOR THE SECOND YEAR PRECEDING THE PERIOD OF TABLE I.

	—Output by— months.			—Deviation— in output.		
	Water	Electric	Uniform Rate	Water	Electric	Electric Peak Load
January	7.48	10.13	8.49	—1.01	+1.64	96
February	7.76	8.15	7.67	+0.09	+0.48	84
March	8.79	8.56	8.49	+0.30	+0.07	79
April	8.80	8.46	8.22	+0.58	+0.24	79
May	9.25	8.12	8.49	+0.76	—0.37	74
June	8.08	7.29	8.22	—0.14	—0.93	72
July	8.59	7.24	8.49	+0.10	—1.25	70
August	6.97	6.94	8.49	—1.52	—1.55	81
September	8.98	7.58	8.22	+0.76	—0.64	84
October	9.45	9.26	8.49	+0.96	+0.77	97
November	8.51	9.16	8.22	+0.29	+0.94	97
December	7.35	9.11	8.49	—1.14	+0.62	100

Table III. shows similar statistics for the second year preceding that of Table I. It shows nothing new in regard to the electric output, but it is notable that in each year the annual peak load came in December, while the lowest monthly peak came in July in two instances and in June in the other instance. The latter averages about 65 per cent of the December peak. The output of water shows rather unusual conditions: the lowest outputs were in December and January, but there was a marked decrease from ordinary conditions during June, July and August and some increase during October. This points to a summer season of unusually large rainfall and perhaps some deficiency during October. While this may explain the results in part, or perhaps wholly, it should be kept in mind that much water is consumed by industrial concerns; and naturally the general activity among the industries will be a factor and will reflect itself in the gross output.

There have been instances where the winter demand for water approached the yearly maximum, caused by waste to prevent freezing in very cold weather. This condition is not a serious factor, however, when the distribution system is properly planned and where house piping systems are installed with care. The waste in any case is greatly minimized by a meter system of charging. The monthly variations of demand, compared for different cities, do not show identical characteristics, particularly in the case of some of the larger cities. In the smaller cities, where consolidated water and electric plants are more common and productive perhaps of greater relative economy, the demands in many cases rise and fall inversely with the electric demands, as a whole.

Summing up these comparisons, it is apparent that there is great probability of a diversity factor between the an-

nual peak demands for the two kinds of service; and in many cases this probability is a practical certainty. There seems to be a sufficient degree of certainty to warrant the expectation that in the matter of primary power production, for pumping water and generating electrical energy, a combined plant will require a smaller installation than separate or independent plants. In steam-driven stations this joint use of installation would include the boiler plant, in any case; and it would extend further, to the engines (or turbines) and generators, in case electrically driven pumps prove to be the most economical under the conditions.

The maximum station demands for power from the prime movers differ widely, as a rule, for the two kinds of service, when supplying the same territory and population. The power required for pumping will ordinarily be a small fraction of the power output of the electric-station prime movers, assuming a normal development of both classes of service. This fraction will range in most cases between ten per cent and twenty per cent as extremes. This means that in the case of electrically-driven pumps, the power required for pumping at the time of summer peak load on the electric station would not increase the peak to its December value. During the winter season the electric peak would be increased somewhat, of course, by the simultaneous demands for pumping.

But water service is essentially different from electric service in one very important particular; namely, water is a storable commodity and under many conditions can be economically stored in sufficient quantities to supply the system, without pumping, for a considerable period. In this respect then, a pumping load forms one of the most desirable classes of service which a central station can secure, that is, off-peak business. This class of business helps to improve the load factor materially and reduces the unit cost of production. It is quite evident that a pumping load will increase the annual load factor of a central station, from the previous consideration of monthly variations of demand. In order, however, to study the probable effect on the daily load factor, it is necessary to study the momentary demands throughout any twenty-four-hour period, for different seasons of the year.

Fig. 1 exhibits two typical electric-station load curves in a small city, the upper curve representing December conditions and the lower one the June conditions. The December curve shows a slight peak about 7 a. m. due to overlapping of lighting demands and the day motor load. The drop between noon and 1 p. m. is caused by shutting down motors during the dinner hour. Commencing at 4 p. m. there is a rapid increase in load caused by commercial and street lighting, which comes on before the motor load goes off; the three together, with some residence lighting, cause the extreme daily peak. There is considerable decrease about 6 p. m as the motor load ceases and some of the stores close. The second peak, about 8 p. m., is due to residence lighting. The night load from 1 a. m. to 5 a. m. is principally street lighting.

The June load curve shows different conditions. The slight morning peak is absent; otherwise the load conditions are similar until 4 p. m. At that time, however, there is no increase and conditions remain uniform until 6 p. m., when the motor load ceases. There is little commercial lighting demand, comparatively, and a consequent drop until the street lighting and residence loads come on; the daily peak occurs about 9 p. m. There is a marked difference between the curves, in total output and daily peak. In small cities with considerable industrial development the daily curves for different days of the week exhibit individual characteristics, due to the practice, for example, of keeping the stores open on certain evenings. Saturday always presents special conditions, owing to the prevalence of a half-holiday. The curves shown in Fig. 1 represent the same day of the week, with normal conditions.

The demand for water service comes from sources which are much more diverse in character than the demands for electric service. Even the domestic demands, by themselves, are subject to great diversity; but added to these are the commercial, industrial and municipal demands—not including fire service. The hourly fluctuations of total demand are consequently less, because of this great diversity of uses and demands, than in the case of electric service. Fig. 2 shows two water-demand curves for a twenty-four-hour period, one for a day in December and the other for a day in June. The lower curve shows the December demand. It is notable that the maximum demand is not a pronounced peak of short interval; instead it spreads over several hours, from about 8 a. m. to noon. The afternoon demand is somewhat less, and at 6 p. m. it decreases noticeably. As a whole it falls slightly through the evening and then remains at a fairly constant minimum through the night until about 6 a. m. From that time, or perhaps a little earlier, it rises quite steadily until about 8 a. m., when the maximum commences.

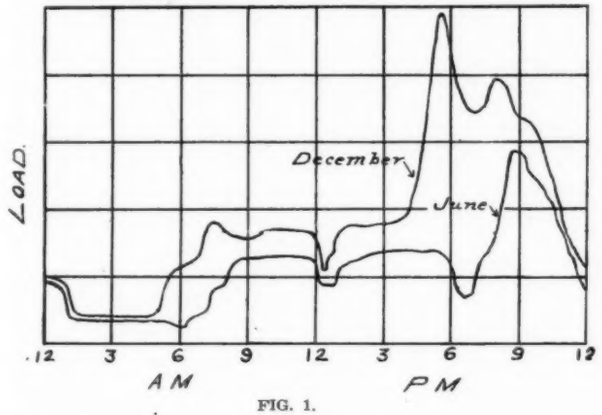


FIG. 1.

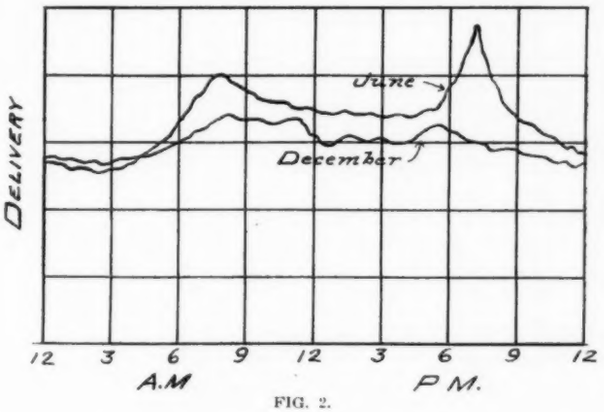


FIG. 2.

One reason for the absense of marked variations of total demand is found in the fact that the leakage in a great many water works systems reaches a substantial fraction of the whole output, considerably above the average percentage of energy loss in a well-designed electric distribution system of any type.

The domestic demands are naturally greatest, as a whole, during the hours of the forenoon, when household activities reach their height. Commercial and industrial demands follow much the same variations as an electric motor load and tend, if anything, toward slightly larger demands in the forenoon than during the afternoon, on account of industries or occupations which complete their daily labors early in the day. The domestic demands extend, of course, into the evening and exist to some extent at all times of the day. Municipal demands, such as public fountains and sewer flushing are practically constant.

The upper curve in Fig. 2, which shows typical demands in June, indicates not only a greater summer consumption, but it shows characteristic morning and evening peaks caused by the demands for sprinkling. In most cases the hours of sprinkling are regulated by municipal ordinance to morning and evening, in order to conserve the water supply. The morning peak occurs about 7 a. m. or 8 a. m., while the evening peak, which presents the daily maximum, comes on about 7 p. m. The differences, as a whole, between the winter and summer demands, from hour to hour, are particularly marked.

In comparing the demand curves of Fig. 1 and Fig. 2, several things are especially noticeable. The curves of winter demand show that there is no pronounced peak of water demand at the time of electric peak demand, although an electric pumping load would somewhat increase the electric station peak, except under conditions to be discussed later. The curves of summer demand show that the respective peaks are non-coincident and separated by about two hours. It seems to be obvious that an electric pumping load, aside from fire-service demands, would not increase the station peak in any marked degree; and undoubtedly it would raise the daily load factor under the demand conditions here shown. The improvement in the load factor would be positive under conditions which permit of shutting down the pumps, or operating at much reduced output, during the hours of electric peak demand.

This now raises the general question of the most advantageous system of producing the required pressure for water distribution, in a combined system. In respect to these methods of producing pressure, water works may be classed as shown in Fig. 3.

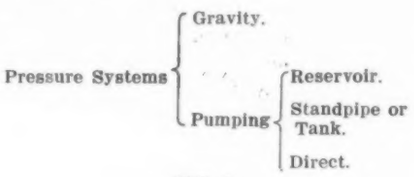


FIG. 3.

The gravity system is, of course, outside of present considerations, or any method making use of natural pressures. In the reservoir system the pumps deliver direct to one or more elevated reservoirs which in turn feed the distribution system by gravity pressure. This method in general is the preferable one where conditions permit its use, because it permits of a large storage capacity and serves not only to absorb the hourly variations in demand and thus permit of a uniform pumping rate, but it enables the pumps to be shut down for part of the day and supplies a large reserve capacity for fire service and possible contingencies at the pumping station. The standpipe system is employed where the natural contours do not permit an elevated reservoir; the reserve capacity is much less, but nevertheless equal to meeting contingencies of a brief duration and absorbing the demand variations to some extent. The direct pressure system depends upon the pressure from the pumps alone and the pumping capacity must be equal to the demands at all times. The last system is generally the least desirable one from every viewpoint, because it requires a pumping capacity equal to the ordinary peak demand plus simultaneous fire service, and, in addition, a reserve capacity to meet possible contingencies to the pumping station equipment.

The demands for fire service form a most important consideration, because adequate protection of this nature is one of the chief advantages of a water works system to any community. In the smaller cities these demands may be several times the amount of the ordinary commercial, municipal and domestic demands. The use of fire steamers is uncommon in such cities and dependence is placed, as a rule, on the water works pressure. It is frequently arranged to shut off the reservoir or standpipe and pump direct to the system, drawing perhaps upon the former in case of severe fires, or upon special reservoirs at lower elevations, provided exclusively for fire demands. In such a case the system is converted temporarily to direct pressure, with the attendant demands upon the pumping equipment. While these demands will not often be large or of extended duration, because large fires occur seldom, it is very necessary to be prepared to fight a general conflagration.

In the larger cities fire steamers are practically universal, outside of the few cases where high-pressure fire systems have been installed; but the latter have been confined to the dangerous districts and steamers are still necessary in the surrounding territory. The demands for water for such service do not amount to so large a part of the ordinary demands as in the case of small cities. The distribution pressure is not increased ordinarily, but, of course, the rate of water delivery to the whole system rises somewhat.

In the ideal case of reservoir pressure, an electric pumping load is of maximum benefit to a central station, owing to the ability to treat it as off-peak business. It then serves to raise the load factor and improve the economy materially. In diminished degree the benefits still exist with the standpipe system; under some conditions it may not be possible to avoid the pumping load at the time of electric peak, but aside from fire demands the pumping rate can be diminished to some extent, at least. The direct-pressure system is, of course, of the least benefit and what advantages exist accrue from the diversity between the respective peaks. Nevertheless, there is ordinarily some benefit to be expected, as the load curves show. These various benefits or advantages of a combined system have been discussed up to this point from the viewpoint of load demands and output. It does not follow, even where the greatest gains are possible in this respect, that a combined plant is necessarily more economical than two individual plants. There are naturally a number of considerations

which enter the problem at this point.

In locating a central station the first feature to be taken up is the electrical center of the distribution system. This location is theoretically the correct one from a distribution standpoint. But from the standpoint of electrical energy production it is necessary to consider the facilities for cheap delivery of fuel and condensing water, also the cost of land and the matter of a suitable neighborhood. A number of possible locations will probably be found, whose advantages are not perhaps equal. Water power may be available also, and in that case the question of location is limited by topographical considerations. The determination of the most economical site can only be made by careful computations of the fixed charges and operating costs in each case, under assumed or known conditions of output. Purely theoretical considerations, although important, seldom fix the best location; matters of a practical nature, such as obtaining a suitable parcel of land with railroad switching facilities and proximity of a natural water supply, are frequently controlling.

In water-works design the feature which exerts the most influence, perhaps, on the pumping-station location is the question of water supply. In this respect there are two principal sources, namely, surface waters such as rivers and lakes, and ground waters from artesian, driven or open wells. The most economical available method of producing the necessary distribution pressure may also affect the question. In general, a consolidated pumping and electric station must be located with reference mainly to the pumping-station requirements. If steam is the primary power, side-track facilities are very essential in any case for delivery of fuel; and an adequate water supply for cooling condensers of the surface type is almost assured at any location of the pumping station. The location and character of the water supply will have so great a bearing on the question of a suitable pumping location, which may be very remote from the center of electrical distribution, that the benefits of consolidation may be overcome by electrical transmission losses. This problem is obviously one which presents special features in almost every individual case and is too comprehensive to discuss exhaustively here. The most careful and painstaking analysis is essential in arriving at the most economical solution in any particular instance.

When separate stations prove economical, under the local circumstances, it is still possible to consider electrically driven pumps, although an intermediate link consisting of the electrical transmission is unavoidable. This link introduces a certain element of unreliability, due to the possible failure of the transmission line; but it can be minimized by the duplication of lines. In respect to the type of line construction, an underground line is, of course, much superior to one overhead, although more expensive.

In analyzing the question of power economy it is well to recognize and consider all the types of pumps that are commonly used in water works service. These types are classified in Fig. 4.

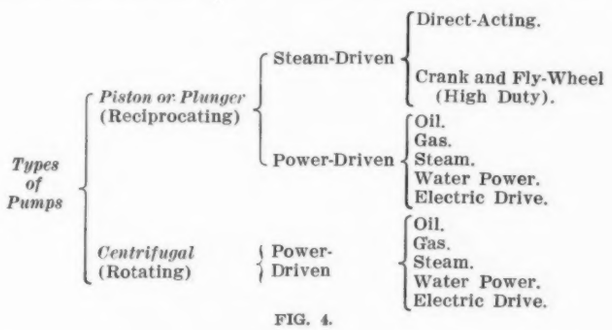


FIG. 4.

Direct-acting steam pumps do not equal in economy the crank and fly-wheel or high-duty type, even with a triple-expansion, condensing steam end. The high-duty type is much superior and in fact is the most formidable rival of the electrically-driven power pump. Unless the cost of electrical energy is comparatively very low, the high-duty type is likely to be the most economical when all the costs are considered. The power-driven types, using belt or gear drives coupled to any primary power source, are too familiar to need description and the same is true of the centrifugal types.

In considering the economies of a combined system, with electrically driven pumps, there is a possible advantage from the standpoint of the central station which has not been touched upon. This relates to the station power-factor, when alternating-current distribution is employed. The power-factor of a lighting load is very nearly unity, but when considerable energy is supplied to miscellaneous motors of the induction type, the power-factor falls perhaps to eighty per cent or even less. The advantages of over-excited synchronous motors in such a case, in improving the station power-factor, are too well known to be dwelt upon in detail. Motors of this type are not well suited for commercial service in the ordinary small sizes, for reasons also well known. But when such motors can be excited from the central-station exciter bus and attended by the central-station employees, they have obvious advantages. While they are not self-starting under load, this difficulty can be overcome by clutches between the motor shaft and the load, thus permitting them to be started satisfactorily in the usual way. The improvement in the station power-factor will be most marked at the time of maximum motor load and least lighting load, or during the period of the usual day load. The synchronous-motor load will still be of some benefit during the peak, if pumping is then necessary. The resultant conservation of generator capacity is a benefit which can be definitely computed in money terms and is important.

In closing it may be pointed out that it has not been the purpose to work out the most economical types and arrangements of equipment in combined or in separate plants; the scope of such a task is gratly beyond the present limits. It has rather been the intent to show the possible or probable advantages of consolidation, without attempting the solution of specific problems in power economy. Even where the advantages here pointed out exist in a considerable degree, it does not follow at once that consolidation is economical. The figures in each case must be the final answer, but there is no certainty that the final choice is the most economical one unless all the possibilities have been weighed and considered, in terms of total costs.

LETTER TO THE EDITOR.

Carbon Tetrachloride.

To the Editor:

Referring to your editorial of February 25, 1911, permit me to call your attention to the danger arising from the use of carbon tetrachloride for extinguishing fires, for the following reasons.

Carbon tetrachloride decomposes at a temperature of 550 degrees Fahrenheit, and burns with a blue flame, assisting rather than retarding combustion, when thrown upon fires which have attained high temperature. It gives almost pure chlorine gas, which is very poisonous, and persons using it upon a fire in a closed room would be apt to suffocate before they could extinguish the fire. It is little short of criminal to give the public an impression which, if followed, may result in disaster.

A well known manufacturer of fire extinguishers has, after years of experiment, discovered a means of neutralizing the above deleterious properties of carbon tetrachloride, by breaking up and combining it with other chemicals. The vapors from the new compound may be breathed with impunity, and it is said to be very efficient in extinguishing all incipient fires. This extinguisher is in general use by the Interborough Rapid Transit Company, the New York Fire Department, and many other large corporations.

Having read your valued journal since it first appeared, I have taken the liberty of giving you the above facts.

GEORGE FREDERICK SHAVER, M. E.
New York, N. Y.

Aluminum Transmission Lines.

In discussion of a paper on the subject of corrosion of aluminum wire, which was read before the Institution of Electrical Engineers, Arthur Jacob gave the results of some of his experiences with the earlier lines. In these, be stated, there were installed copper binders and clamps of other metals than aluminum and as a result of this, trouble from galvanic action was experienced. When ordinary precautions, however, are taken in this respect no difficulties need be anticipated from corrosion. He added that, in general, his experience with aluminum goes to prove that it will withstand weather conditions at least as well as copper.

Electric-Vehicle Tires.

A meeting of the Electrical Vehicle Association of America was held on March 28 at the Engineering Societies Building, New York City, when the topic of tires was taken up.

Chairman W. H. Blood, Jr., announced that nearly $25,000 had been raised from central stations for a publicity campaign and that a like amount was to be collected from the manufacturers.

Mr. Smith announced that the membership stood at 240 and that the campaign under way should materially increase this figure.

The paper of the evening "Tires—Their Use and Abuse" was read by the author, Dan S. Swander.

TIRES.

In pleasure-vehicle tire equipment opinion is somewhat divided between solid and pneumatic tires. Some manufacturers design the springs of their cars with the view of using one or the other kind of tire equipment. Mr. Swander's view is that the pneumatic tire, especially designed for service on electric pleasure vehicles, cannot be made to secure both economy in current consumption and satisfactory mileage. With this in view his company has dismissed the pneumatic tire as a possibility on pleasure cars. The moderate speed at which electrics are driven does not demand the superior resiliency of the pneumatic tire to protect against jarring the batteries and mechanism. The drift of sentiment today is in favor of special solid tires.

With respect to commercial electrics the tire question is serious. Mr. Swander believes that the use of the pneumatic is not to be considered seriously on account of the great weight of loads and the destruction these loads would necessarily bring upon pneumatic tires. Of prime importance to the electric-vehicle owner is the current consumption of the vehicle as affected by the resiliency of the tire. This resiliency is affected by the secret rubber compound of which the tire is made. It is of the greatest importance to have a tire that will make a low demand for energy and at the same time have ample resiliency to prevent jarring. A hard tire will draw less current than a very soft one, but the damage it will do to the batteries and mechanisms makes a hard compound entirely out of the question. A resilient tire that will absorb shocks will often consume so much power as to make it costly in operation and expensive to maintain, and will also pull down the mileage. A soft tire is not necessarily an expensive tire. A tire, however, that combines economy of current consumption with proper resiliency and good wearing quality is very expensive to produce.

The discussion proved to be a series of questions and answers. Mr. Lloyd suggested that the question of standardization could best be begun with the size of the wheels.

Mr. Blood asked as to whether there was some ready test which could be applied to ascertain whether a tire was first class or not and Mr. Swander's answer brought the fact that an old tire is better than a new one and that the real value of a tire depends much upon the care it received both in use and in storage.

Mr. Appleton questioned the superiority of the solid tire for the electric pleasure vehicle as a speed of over twenty miles an hour was ont uncommon, but the opinion seemed to be that pneumatics were rather a luxury on electrics.

Regarding the question of carrying capacity it seems that the dual-tread tire has considerable advantage over the single tread, and that the problem of supporting the ten-ton trucks had not been properly solved.

Referring to substitutes for rubber, it seems that while there have been hundreds brought out, practically none were of any value and the tire makers look to a steady and reasonable price for rubber rather than a substitute.

Messrs. Wagoner, Wilcox, Howland and Madden also joined in the discussion.

Underwriters Take Action on Grounded Secondaries.

A resolution was passed at the meeting of the Underwriters National Electric Association held in New York City, March 22, urging municipal departments to make the grounding of secondary circuits up to 150 volts mandatory; urging the underwriters' inspectors to recommend such grounding at all times; urging the National Electric Light Association to impress upon its member companies the necessity for such grounding; urging the departments in charge of water works to permit the attachment of ground wires to their piping systems; urging all concerned to give careful consideration to their methods of obtaining satisfactory grounding where water pipes are not available; and urging the American Institute of Electrical Engineers to use its efforts to harmonize the present difference of opinion as to the limiting voltage at which grounding ceases to be desirable and to determine the proper limit.

Annual Meeting of American Institute.

The annual business meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York, on the evening of May 16. The result of the ballot for officers will be announced.

Electrical Notes From Great Britain.

By Our British Correspondent.

On March 20, at the Institution of Engineers and Shipbuilders in Scotland, Thomas B. Mackenzie read a paper on means for economizing fuel and utilizing waste heat in malleable-iron and steel works. Among other statements was one to the effect that the "so-called exhaust turbine, is a much over-rated piece of machinery." He referred to the desirability, where there are blast furnaces, of using the waste gases from them in gas engines both for blowing the furnaces themselves and for providing the electrical energy necessary to drive the mills, etc., in the steel works. "It might then happen that the ordinary power requirements of the whole works were met without requiring any steam. In that case, if waste is to be prevented, some other use must be found for the steam generated by the waste heat from the smelting furnace." In some districts it might do to dispose of this to the local power company, but where this outlet cannot be found, "electric refining of part of the steel made might with advantage be resorted to." It was calculated that six smelting furnaces would be required to supply steam enough to provide energy for a fifteen-ton electric refining furnace. Mr. Mackenzie collected and compared the several methods considered in the course of his paper for economizing fuel and utilizing waste heat, either in exhaust steam or chimney gases, arranging them in order of merit, thus:

Method of economizing fuel or recovering waste heat—	Fuel required for steam-raising purposes.	Saving per cent.
Hand-fired boilers, cold feed, non-condensing engines, steam pressure 100 pounds by gauge	100.00	0.00
Hand-fired boilers, exhaust feed heater, non-condensing engines, steam pressure 100 pounds by gauge.	89.00	11.00
Hand-fired boilers, hot feed, non-condensing engines, with exhaust turbine, boiler pressure 100 pounds by gauge	65.30	34.70
Hand-fired boilers, hot feed, superheated steam, compound engines, steam pressure 100 pounds by gauge	58.70	41.30
Hand-fired boilers, hot feed, superheated steam, triple expansion engines, pressure 150 pounds	48.00	52.00
Waste-heat boilers plus live gas, economizer, superheated steam, compound engines, steam pressure 120 pounds by gauge	33.00	67.00
Gas-fired boilers, pre-heated air, economizer, superheated steam, compound engines, steam pressure 120 pounds, Mond gas	19.30	80.70
Waste-heat boilers plus live gas, economizer, superheated steam, turbo-electric drive throughout, steam pressure 120 pounds	18.00	82.00

The author said it was obvious that in the case of the waste-heat boilers the use of Mond gas would still further reduce the cost of fuel. The above are the savings in fuel only; the net saving would, of course, have to be arrived at by taking into consideration the cost of the apparatus necessary to obtain it.

The Institution of Civil Engineers here has just devoted two of its meetings (March 14 and 21) to consideration and discussion of a paper by Philip Dawson on the single-phase electrification of a portion of a suburban railway, namely the London & Brighton system, for which Mr. Dawson is the consulting engineer. It will be remembered that 6,700-volt overhead conductors (frequency twenty-five cycles) were adopted, and as the author remarked, the selection of the single-phase system was in the beginning severely criticized by many engineers and foredoomed to failure, but thirteen months' regular working had entirely justified its adoption.

The Torquay surface-contact tramway, about which there was much discussion last year, has now been converted to overhead trolley at a cost of $55,000 for the eleven miles. At Hastings there is now a renewal of the agitation for the abandonment of the surface-contact system along the sea front. The tramway company wants to be relieved of this burden and to have its entire system trolley throughout. Only at Wolverhampton and Lincoln is surface-contact working running peacefully and without opposition.

The power station at Lot's Road, Chelsea, has been much in the public mind during the past few weeks. The desire of the District and the Speyer tube group to control and operate it under a joint committee, has been discussed in detail before a Parliamentary committee, and the preamble of the bill has been passed. It is unlikely that anything will happen to hinder its passage through the later stages, for its promoters by agreeing with their opponents—a strongly united body of electricity-supply authorities who were prepared to fight to prevent a new competition entering the field for supplying power to various authorities and private consumers—have lightened the proceedings by averting a strenuous and costly contest. The Lot's Road owners, as things now stand, may shortly be empowered to supply a number of other railways besides those for which they already have authority, and they have eased the way for securing this power by dropping their idea of wider supply which a little while ago looked like producing a repetition of the Merz power scheme fights of several years ago. At this present inquiry Mr. Merz appeared and gave evidence concerning the increased capacity of the Lot's Road plant, and the ease with which it could be added to very considerably. This Chelsea power station has also been to the fore by reason of the interesting announcement which which was made by Sir Edgar Speyer on March 15 as chairman of the London Underground Railways Company regarding the now celebrated arbitration proceedings concerning the turbines and turbo-alternator sets which were installed by the British Westinghouse Electric Company under its first contract for this power-station installation. Sir Edgar said that the contractors claimed over $415,000 for the balance of the contract for the plant supplied, and the railway company resisted the claim on the ground that the turbines were defective and not up to the contract, resulting in such an excessive coal consumption that after full efforts to improve them they had to scrap their turbines and buy Parson's turbines, the cost of which, with installation, had been $390,000. The railway company at the same time counterclaimed for damages chiefly on account of extra coal consumption. The arbitrator's award is entirely in favor of the railway, he having decided that the contractors are not entitled to recover any sum whatever, but that they have to pay the railway over $75,000 for damages, and arbitration costs in addition.

Some of our municipal electrical authorities are again having brought home to them the necessity for expediting the repayment of their loans of earlier years. Periods which were fixed as reasonable years ago when less was known about plant supercession, require alteration now after we have had so much experience in the substitution of modern equipments long be-

fore the original loans have been paid off unless we are to continue paying interest on capital and repaying that capital long after the plant which was bought with it is scrapped and forgotten. The London County Council in advising the Saint Pancras Electricity Authority on this matter has recommended that instead of being so generous in voting profits to the relief of the rates they should increase capital repayments so that over the next thirteen years the additional sums will range from $21,000 next year to under $1,000 in the last year of the period. There is a disposition to refuse to adopt the recommendation on the ground that it would place heavy financial burdens upon the ratepayers for the next thirteen years. This is another way of saying that the ratepayers would receive less profit for the reduction of the local rates, for the amount so allocated in 1909-1910 is stated to have been nearly $40,000. Sound financial policy would certainly seem to be along the path pointed out by the London County Council. ALBERT H. BRIDGE.

London, March 22, 1911.

Aluminum Anode Films.

A paper on "Some Properties of Aluminum Anode Films," by O. E. Bairsto and R. Mercer, was presented to the Faraday Society at the last meeting in London.

The paper gives a preliminary account of an extended investigation that is being made into some of the properties of aluminum anode films, with special reference to the capacity of such films, and to their behavior in several electrolytes that have not, previous to this, been used to form them. The differences found by previous observers for the capacity are explained by the experimental difficulties involved in measuring a very leaky condenser, and by the influence of the length of the period of formation. The capacity decreases slowly with the time of formation for several days. The higher the formation voltage, the longer is the time required for the capacity to fall to its minimum value. The product of the capacity per square centimeter and the formation voltage is not constant, but decreases with the voltage, ranging from 8.1 to 6.9 for the range of voltage 10 to 119.5. The electrolyte used was concentrated $(NH_4)_2B_4O_7$. From the analysis of the measurements made by various observers of the dimensions of the films, and from the thickness calculated from the capacity, it is concluded that the film is composed of an inner thin dielectric stratum, which is independent of the electrolyte, enclosed by an outer and much thicker conducting film, varying with the electrolyte. A study of the valve action of electrolytes of bivalent or higher acid radicals, K_2FeCy_6, K_4FeCy_6, $NH_4H_2AsO_3$, $(NH_4)_2HAsO_4$, and $(N_2H_5O)_2.7MoO_3$, shows that with the exception of the last none are of any use for building up a high insulation resistance. With $NH_4H_2AsO_4$, it was found impossible to rise above fourteen volts without extensive pitting taking place; the addition of NH_4OH to the extent of about five per cent completely stopped the pitting, and it was then possible to reach a voltage of 400. There are three points of interest on the volt-resistance curves: (1) A point at which maximum resistance occurs. (2) The critical voltage, at which no reduction from the first value of the current on closing the circuit takes place, but instead an increase. (3) The breakdown voltage. It is shown that the law of increase of leakage current with temperature is an exponential one. Experiments were made with alternating currents employing a constant electromotive force, and a variable series resistance, with increasing volts across valve cell; it was found that the current was constant over a considerable range of voltage, the volt-current curves for a number of electrolytes being parallel to the axis of voltage. This is explained by the fact that the capacity decreases as the voltage rises; at the same time the resistance increases. The result is that the effective admittance is practically inversely proportional to the voltage. The effect of temperature on the capacity of anodes was investigated, and it is shown that temperature has considerable influence. Each electrolyte behaves in a characteristic manner, and Na_2HPO_4 gives on the whole a decrease of capacity with temperature, while $(NH_4)_2B_4O_7$ gives a considerable increase, a large proportion of which persists on cooling down to normal temperature again.

Coal Lands and Water-Power Withdrawals.

Over seventy million acres of coal land in the West is still owned by the United States Government. The coal tonnage of this land is stupendous; it can be figured only in hundreds of billions of tons. Some tracts are of immense value, containing beds of the highest-grade coal, thirty, forty, fifty and even eighty feet or more in thickness. The old way was to sell the coal land, regardless of value, at the absurd price of $10 an acre if it was more than 15 miles from a railroad, or at $20 if within that limit. The present way is to measure up the coal in an acre and sell the land on the coal-tonnage basis. As a result coal land has been priced as high as $400 an acre and in one tract at even $600 an acre. Since March 4, 1909, the Geological Survey has classified by individual forty-acre tracts, 8,527,166 acres of the Government coal lands, with a total valuation of $560,815,081, and this, added to the results of former work, gives a total of 13,480,538 acres classified as coal lands, at a valuation of $637,619,418. It may be noted that the proceeds of coal-land sales are all deposited to the credit of the irrigation reclamation fund.

The scheme under which this geological classification and tonnage valuation has been worked out is remarkably accurate and scientific. The Government has withdrawn 62,140,548 acres of probable coal land as a result of geological field examinations and has restored to agricultural entry 18,000,000 acres found to be non-coal in character.

Water-power withdrawals on public lands by the Geological Survey in aid of proposed legislation have included thousands of power sites. Withdrawals made during the last two years cover 161 streams in twelve states and include 1,403,054 acres.

Use of Water Power in Oregon.

By an Act of Legislature passed about two years ago, the State of Oregon adopted a system of public control for her water resources. Rights to the use of water for power development are limited to a period of forty years, subject to renewal under the laws then existing. Compensation to the public for the use of the water is provided therein.

Under the old law no foundation existed for titles to water. Utter confusion prevailed as to the legal status of a water right and litigation among water users occurred to an enormous extent, and there were many quarrels over the proper division of streams. The object of the present law is to secure a proper division of streams among those entitled to use them. It also systematizes titles to water. County water-right records have been abandoned in favor of a central office of large powers. The state engineer and two superintendents sitting as a board have power to determine all water rights on a given stream upon the application of any user of the water. The determination is based upon field surveys and testimony taken by the board. The certificates issued by this board are to the water rights what a patent from the United States Government is to the land title.

Peat Bogs of Canada.

A recent newspaper clipping from Windsor states that there are 12,000 square miles of peat bogs in Ontario and Manitoba, enough to supply 5,306,076 families with fuel equal to ten tons of good coal each for 100 years. In 1909 Canada imported nearly 10,000,000 tons of coal, worth $26,831,859, which sum the newspaper thinks might be kept at home if peat were used.

Electrical Notes from Continental Europe.

By Our Paris Correspondent.

The central electric plant of Stockholm has been much increased of late by the addition of steam turbine groups so that at present its capacity is more than doubled. Before the increase there were installed five 1,500-kilowatt groups, and two of these were steam-turbine groups. Larger sizes are used for the new part of the plant, and there are now installed two steam-turbine sets of 6,000 kilowatts each. All these units are designed to deliver three-phase current and work at 6,000 volts and twenty-five cycles. In the Stockholm plant a separate building is used to contain the switchboard apparatus and busbars with all the appliances for handling the circuits. Each of the new 6,000-kilowatt steam turbines has a separate battery of four Babcock and Wilcox boilers, together with two Green economizers, besides turbine pumps and electric-motor-driven pumps. The steam turbines are built by the Swiss Oerlikon Works. One of the noteworthy features of the station is a very well-designed coal-handling plant, by which the coal is taken from the cars and delivered to the station yard. About 100 tons of coal per hour are thus handled. The circuits from the central station run to five different substations located in the city in order to distribute the current to the mains.

Engineer Vinson, of the West Railway department at Paris, uses an ingenious device in order to test incandescent lamps for use on railroad cars, and is at present engaged in having metallic-filament lamps made which will be able to stand this severe use. He imitates the shocks which the lamps receive on the road by a device in which the lamp is mounted, and by using a small motor-driven cam a succession of shocks is given the lamp. When the filament breaks the current is cut off from the motor by a suitable relay, and a counter on the shaft shows the number of revolutions or shocks. Slight or heavy shocks can be given by a spring, and the apparatus goes on working without needing to be watched. The number of shocks which the lamp stood is read off at once from the counter.

A well-designed electric plant is mounted on the new Norwegian submarine boat *Kobben*, built by the Krupp establishment at Kiel, Germany. Each of the two screws is direct-driven by a 220-horsepower Diesel internal-combustion engine running with crude oil and on the same shaft is an electric motor which drives the shaft when the boat is submerged. As usual, the motors are also run as dynamos to charge the storage battery. The cells are stored under the flooring and are placed in air-tight compartments. When submerged, the electric motors give the boat a speed of nine knots per hour.

In addition to the great Brusio hydraulic plant in the south of Switzerland, and lying next the Italian frontier, it is proposed to make use of other available hydraulic power in the same region so as to obtain no less than 70,000 horsepower. A Zurich company is engaged on the enterprise, and the plans call for the building of two separate stations, one at Bergün and a second at Filisur. These plants will use the power of the Albula, Landwasser and other streams.

The most recent news as to the new Mercadier multiplex telegraph system shows very favorable results. It will be remembered that it uses waves of different frequencies over the same wire, each to work a separate selecting receiver. Not long ago it was tested on a single wire between Paris and Lyons. The selective receivers work relays so that direct-current printing telegraph receivers of usual types can be used if need be, along with other printing telegraphs using pulsating current. Thus in the tests there were used a direct-current Baudot quadruplex printer besides six different Hughes printers working on vibratory current. The Mercadier system allows of adding the latter six instruments on the same wire as the usual quadruplex, so that the capacity of the line is much increased. Any other kind of receiver, such as Wheatstone or Morse, can be used with equally good results. It is to be noted that the Mercadier apparatus is of a very simple construction.

One of the most recent trackless trolley lines is now running in the suburbs of Bremen, Germany. It is designed to give an extension from the city tramways towards the suburbs. The cars are built on the same lines as an autobus and are attached by cable to a roller trolley running overhead upon a pair of wires. In the present case the two wires are run one above the other and spaced eight inches apart. The trolley has two rollers which run upon the upper wire so as to suspend the whole, and below are two bow contact pieces which bear upward against the lower wire. The cars have a small 550-volt motor mounted so as to drive the rear axle by differential gear. Owing to the use of a drum for winding up the slack of the cable, the cars can run over a considerable range without any difficulty. Such cars have several advantages over a gasoline autobus, as they are much lighter and cost less to build, besides making greater speed. Current is supplied from the Bremen city tramway station.

The new Fontana extensible mast which has been brought out in Germany can be put to a variety of uses. In the electrical industry it is well adapted for wireless telegraphy or for supporting lights. What is novel about the mast is that it is made up of flexible steel strips wound upon four reels representing four sides of a square, and is fed up through a square hole in a guide plate. As the steel strip has interlocking teeth, the result is that a hollow column is formed and driven upwards. At the same time a set of encircling brace plates of this steel are put on and automatically spaced along the column. Weights up to two tons can be supported on a sixty or seventy-foot mast, and are lifted up from the ground. Such masts are quite portable and can be used in large halls for cleaning or trimming lamps and many other purposes.

During the Turin exposition there will be held an electrical congress from September 9 to 11, which promises to be of interest. At present the organizing committee are engaged in selecting the authors of various papers which are to be read. This does not exclude other communications, which will be also received and examined. Among the questions to be treated are the run-

ning of plants in parallel, transformer cooling, frequency transformers, comparison of carbon and other incandescent lamps, steel production in the electric furnace, water sterilizing, submarine boat electric plants, besides many others relating to electrical machines and practice.

Electric locomotives are to be used quite extensively on the new Swedish line running from the Kiruna region to the frontier. Current will be supplied from the Porjus hydraulic plant, which is already well advanced in construction. Both passenger and freight locomotives are now ordered from the builders. Two passenger locomotives will be built by a Swedish firm, as well as two slow-speed freight locomotives, while the rest of the outfit, or eleven freight locomotives, is ordered from the German Siemens-Schuckert firm. These latter present some new features, as they are of the double type and are made up of two separate halves coupled together. Each half, however, can work as an independent unit and thus provide against accidents. Such half-locomotive has three axles which are coupled by driving bars and are driven from a single motor. This latter is mounted upon the flooring of the chassis and lies within the cabin so that it is accessible and also well cooled. Current is furnished to the motor by a transformer which is mounted on the locomotive. It is expected that the electric railroad will be ready to begin running by the middle of 1914.

A new method of rapid formation of storage-battery plates has been brought out in Germany. This consists of three operations, first to form a layer of spongy lead suboxide, second, reducing the oxide so as to give negative plates; third, obtaining positive plates by transforming the metallic lead into peroxide. A bath of ten-per-cent phosphate of soda solution is used to form the layer of oxide, and the plates are put between cathodes of equal surface, spacing by 0.4 inch, and working below 2.6 volt. The plates are soon covered with a layer of yellow oxide. To reduce this we charge the plates at one ampere per cubic decimeter in 1.18 specific gravity sulphuric acid, then after hydrogen is given off, the plate is washed for twelve hours. This gives negative plates. When positive plates are wanted, these latter are charged as anodes in 1.09 sulphuric acid at the same current density as above till all the oxygen is given off. From twenty-four to thirty-six hours' time is necessary.

Successful experiments are being made in France with wireless apparatus mounted on aeroplanes. Not long since, a Farman aeroplane fitted with the new Ancel apparatus was able to send signals to the balloon shed, during trials at the Buc aeronautic grounds. According to a report made to the Academy of Sciences by M. Senouque, the aeroplane carried a four-inch spark coil and four storage cells. One pole of the spark gap was connected to the steel brace wires and other metallic parts of the aeroplane and the second pole was joined to the aerial. This consists of a double wire suspended from the rear of the aeroplane, using 0.4-millimeter wires hanging down parallel to each other and 165 feet in length. The whole wireless outfit weighs about forty-five pounds. On these flights Mr. Farman mounted the aeroplane alone and also worked the apparatus. At the shed the receiving aerial is a wire mounted horizontally on twenty-five-foot poles, this wire being 200 meters in length. With the present outfit the signals could be sent when the aeroplane was eight miles from the shed. But this distance is to be much increased on the forthcoming tests. Here an eight-inch spark coil will be used and the aerial hanging from the aeroplane will be 100 meters long, so that a much greater range may be expected. A passenger will be carried in this case and he will work the apparatus.

Not long since an electric traction line was opened for service in Austria, between Innsbrück and the suburban points of Mount Isel and Hall. At the city end the line makes connection with the tramways, and like these, it uses 500 volts direct current. A double trolley is employed on this first section, which extends past Mount Isel to the intersection with a local railroad. From this point to the terminus at Hall, the line is operated on 1,000 volts direct current, using a single overhead wire with catenary suspension. Another electric road also starts from the city in another direction, running to the locality of Fulpmes. It is operated on the single-phase system.

The longest electric line in Austria has about forty miles length and runs from Trient to Male. It uses 800 volts direct current, which is supplied from three substations located along the line, employing 20,000 volts on a power line coming from the Sarca hydraulic plant on the Trient River. The motor cars, of the narrow gauge type, have four axles each carrying a fifty-horsepower motor. The present line uses motor cars and trailers as well as a considerable number of freight cars and two postal cars.

Messrs. Urbain and Feige are working upon a new form of arc lamp with a mercury cathode which they recently presented to the Academy of Sciences. The anode is formed of tungsten and is used together with the mercury cathode in a vacuum or an inert gas, being spaced three-sixteenths of an inch. By using tungsten the inventors overcome the difficulties which prevented using such a lamp in practice, as the tungsten does not melt. An arc is formed between the tungsten and the mercury and the former metal is brought to a high heat and it is not worn down, so that the lamp will have a long life. The inventors claim that the efficiency is very high, this being 0.45 watts per candlepower. The lamp now works on twelve volts, but no doubt it can be designed to take a higher voltage by increasing the pressure of the gas. It gives a very white light.

A. DeCourcey.

Paris, March 15, 1911.

Pittsburg Section Meeting.

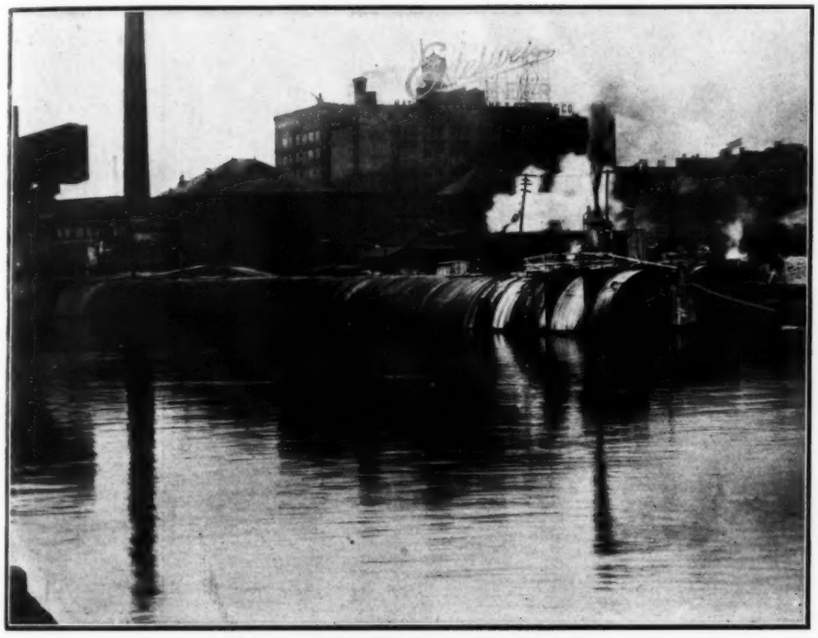
D. B. Rushmore addressed the Pittsburg Section of the American Institute of Electrical Engineers on "Some Aspects of Modern Power Transmission" on March 14. The developments of the large American power systems were described and slides were shown illustrating many features. It was stated that the present tendency is for the power companies themselves to develop or acquire the industries affording the market for the power. There is also a strong tendency for many water powers to be connected to one transmission system, thus giving greater continuity and reliability of service and permitting one generating system to be aided at times of low water by others whose periods of lowest water are not likely to be coincident.

Exports of Copper.

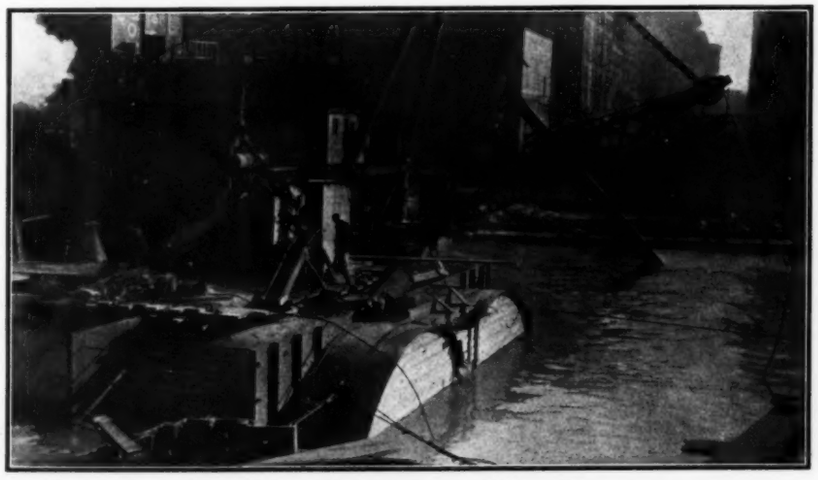
Exports of copper for the week ended March 30, were 6,522 tons. Since the first of the month the amount was 23,275 tons, as compared with 19,541 tons for the same period last year.

Rebuilding the La Salle Street Tunnel.

The rebuilding of the three street-railway tunnels under the Chicago River is coincident with the remarkable rehabilitation of the Chicago street railways and is also in accordance with the demands of the Federal government for an unobstructed river channel. The three tunnels affected under this rehabilitation, which was carried on under the supervision of the Board of Supervising Engineers, Chicago Traction, are the Washington Street, the Van Buren Street and the La Salle Street tunnels. The two former are completed; the latter is fast nearing completion and it is in the rebuilding of this one that unique methods were employed.



TUNNEL TUBE FLOATING AT WHARF.



LINING THE TUBE WITH CONCRETE.

Owng to the conditions under which the La Salle Street tunnel had to be rebuilt a unique method was adopted. The general scheme was to build a steel-tunnel shell at some convenient place; then to float it and then tow it to the site, to be sunk in a trench in a river bed to the desired depth and connected to the corresponding land tunnels. In accordance with this plan a steel twin-tube shell, having the tubes separated by a vertical wall which would give longitudinal strength and rigidity was built. The total thickness of the shell at the roof is only two feet. Its length is 278 feet, with a width of forty-one feet, and a depth of twenty-four feet. In section it is composed of two parallel steel cylinders, each about seventy-five per cent of a complete circle. The cylinders are twenty-four feet in diameter. A circular opening in each cylinder, near the dividing wall, provided means for lining the tubes with concrete.

The shell was built complete in dry dock, on the north branch of the Chicago River, about one mile from the tunnel site. While in the dock the concrete in the center wall was placed. The ends of the tubes were also closed with temporary, water tight bulkheads. The weight of the tunnel shell when floated in this condition was about 3,000 tons. It was removed from the drydock on November 21, 1910, and towed to a wharf, near the tunnel, where the depth of water would permit the completion of the interior concreting. This concrete increased the floating weight to 8,000 tons. A view of the tube when moored at the wharf is shown in the accompanying illustration.

Upon the under side of the shell, at points about fifty feet from each end, were formed special blocks of concrete with a level bottom, protected by steel plates, to serve as bearings in landing the tubes and adjusting them to the desired alinement and grade. Seats for the tunnel shell were provided at corresponding locations in the river bed. Between these seats the shell will be supported uniformly by sand which will be pumped into the space beneath the tube.

While the river bed was being prepared for the tubes two steel flues of sufficient height to extend above the water, when the tube was sunk, were built, one at each end of the tube. These flues were supported by timber towers. On Sunday, April 2, 1911, all arrangements having been completed, the tube was swung into position and by allowing water to enter the flues, was sunk. After the bores had been placed in position two barges were placed at each end. The barges were connected by steel girders, from which wire cables were run under both ends of the tubes. Each barge was supplied with a donkey hoisting engine. Four tug boats and four derrick barges kept the barges in position. It was extremely difficult to keep the tubes in a level position, as the water frequently shifted about and caused one end of the tubes to sink lower than the other. When this occurred water was run into the opposite end and the hoisting engines were brought into play.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN.—XXVIII.

HYDROELECTRIC DEVELOPMENT.—I.

BY W. B. GUMP.

The commercial use of hydraulic power had its beginning half a century or more ago. Until twenty years ago practically all of the hydraulic power developed was used for grinding grain or operating mechanical appliances which were geared to the wheel shaft. The hydraulic efficiency was low and the power transmitted was entirely mechanical. It is only within the last score of years that the transmission of electric power has assumed commercial proportions, and it may be said that at the present time hydroelectric development is so important that feasible undertakings in this sphere are eagerly sought by capitalists, the securities being considered among the most substantial to be acquired.

In order to deal comprehensively with this subject, the fundamentals will be outlined, and a general analysis given which may be considered applicable to typical developments, keeping in mind the fact that no single type is representative of all plants; that the local conditions govern the character of the design, and thus the variety afforded extends over a wide range.

The chief items connected with a hydroelectric development are:

(a) Preliminary Considerations.
(b) Type of Development.
(c) Dams, and Retaining Walls.
(d) Headworks.
(e) Water Conductors.
(f) General Construction of the Plant.
(g) Mechanical Installation.
(h) Generators.
(j) Switching Arrangement.
(k) Transformers.
(m) The High-tension Side.

(*a*) *Preliminary Considerations.* — Chief among the preliminary considerations is the matter of cost. It was previously stated that the average steam-electric plant can be built for a lower cost per unit of rated output than a similarly rated hydroelectric plant. The principal item favoring hydroelectric power is the inherently lower cost of operation. When considering the investment charges of a hydroelectric project along with those pertaining to a similar steam power plant, the choice becomes more closely drawn, and the true comparison is brought to light.

In sections of the country where fuel is very scarce, hence costly, the utility of hydroelectric transmission may reach a high mark, while hydroelectric development in other sections is not a commercial proposition, and steam or gas power becomes supreme.

Within the past three years the conservation movement has stimulated hydroelectric development, inasmuch as it has aroused the public mind to the point of realizing the real aspect of the fuel situation, with the consequent result that all water powers which are within the scope of commercial development are attracting the attention of the engineer and the capitalist.

Government restricions as to water rights have come about naturally, and are the only safeguard between the public interests and unlimited private monopoly. In its final analysis, however, any water-power monopoly in which the power corporation overcharges its consumers, works to bring about an automatic adjustment of rates, from the fact that isolated steam plants are able to produce keen competition and thus bring the rate down to a reasonable value. This has been clearly exemplified in the case of a number of municipal plants which have been made the objects of a most bitter rate war in which corporate interests have attempted to force these plants out of business, or assume conrol of them in order to maintain high rates. Electric power service supplied from hydroelectric power corporations in competition with hydroelectric municipal plants has met the same situation, the usual result being a readjustment of rates.

Under the conditions just noted, the average hydroelectric property is not producing the large profits it is apt to be given credit for, and when such competition is investigated at the inception of the project the feasibility of a proposed water-power development may be questionable when viewed from the capitalist's standpoint. In other words, a number of hydroelectric properties may be cited in which the profits are indeed low, and in some cases plants of this character have become financial failures.

In the nature of things the factor competition, generally speaking, is a wholesome one and usually brings about economy in a way which is certain to benefit the power consumer at large, without working a hardship to the corporation concerned, though profits may be considerably below the figure which was originally presented to those interested in the development.

The item of cost will necessarily limit the proportion of maximum stream flow to be developed. The nature and extent of the power market will also influence the decision in this respect. However small the beginning, the market is certain to extend. The rapidity of growth is more or less uncertain, and therefore the extent of initial devlopment best suited to the conditions is often difficult of determination.

It is the power market which controls the situation, and hence the entire problem is primarily a matter of finance, inasmuch as the profits on the sale of power form the basis for development. If the plant is constructed for maximum stream flow at the outset, the station load factor, that is,

$$\frac{\text{average daily load in kilowatts}}{\text{total rated capacity of station}}$$

will be exceedingly low, and will result in such high fixed charges as to partially or wholly offset the profits, requiring months, or even years, to bring the

plant to a paying basis. If, on the other hand, a development is made for minimum stream flow the output of the plant becomes inadequate to the demands during most of the year and auxiliary power must be supplied almost continuously, the latter source corresponding to the wasted hydraulic power. It is evident, therefore, that a balance must be found between these limits, which will produce maximum earnings on a capital outlay suited to the power requirements in hand. This assumes, of course, that due consideration is given to the matter of future extensions.

Reliable records of stream flow are difficult to secure, and should in all cases cover a long period in order to form a basis for definite conclusions as to the practicability of development. Records should extend over a number of years, and include such items as

(1) Precipitation.
(2) Evaporation.
(3) Run-off.

which are to be studied in connection with the topography of the drainage area. The items above referred to may generally be learned from maps and data furnished by surveys of the Federal Government. When these are not available, calculations form the only means of arriving at results. However, there are few instances in which previous records cannot be obtained.

In view of the fact that a completed hydraulic development suitable for the physical requirements of future growth may be overburdened with fixed charges, Henry L. Doherty has suggested installing a steam power plant in the vicinity of the market and constructing the distribution lines prior to building the hydraulic generating station. As the load increases the steam plant can be extended to meet it, until finally a load suitable for the hydraulic plant will be reached which will justify constructing this plant. The steam plant would then become a reserve source, or could run continuously as a regulating plant, and be prepared to carry peak loads. A steam plant is not encumbered by the disadvantages of low water, and where fuel can be purchased and transported at reasonable cost such a plant is indispensable in connection with almost every hydroelectric transmission system.

(*b*) *Type of Development.*—There are two general methods of hydraulic development: (1) direct or centralized development, and (2) diversion.

The first method is employed in cases where it is feasible to utilize the entire head at the dam, the plant being located at one end of the spillway or in its interior. The advantages of this scheme of development are: first, a reduction in cost of construction; second, greater hydraulic efficiency, due to the elimination of friction otherwise involved in flumes and pipe lines; third, a reduction in operating expenses, on account of centralization, which means that the operation of head gates, the cleaning of racks, and (in cold climates) the elimination of ice, are all reduced to their lowest terms. Where flumes and pipe lines are used, the evaporation, leakage, and loss of head, are all increased in proportion to the magnitude of these works, and the first cost and operating expenses are accordingly augmented. Direct development is ordinarily limited to heads not exceeding about seventy-five feet, and more often is not over half this figure. No exact limit can be given, however, as there are exceptions to every rule, and local conditions may justify a development which is quite remote from general practice.

The second method (that of diversion) is applicable to cases where topographical conditions, such as a contracted channel, or a dam too low to accommodate the plant, prevent a direct development. The problem in this case is to determine the most economical diversion for the market conditions and other local factors related to the project. In general the diversion should be as short as possible. In other words, the distance between the intake and the station should be only sufficient to utilize the available volume of water in the most effective manner. Careful estimates of the cost of construction of several schemes afford the only means of arriving at the most economical one. Before estimates can be made, preliminary surveys are required showing the topography and the nature of the strata in the vicinity of the proposed development.

High-head developments, that is, those involving heads above 100 feet, are usually of the "distant diversion" type in which long canals, flumes, or pipe lines are required between the intake and the power station. Exceptions may be cited in the case of several Niagara Falls plants having heads from 140 to 170 feet, in which a form of direct development is applied. The plants referred to are those of the Niagara Falls Power Company, the Canadian Niagara Power Company, and the Toronto & Niagara Power Company.

The plant of the Ontario Power Company is operated by means of pipe lines 6,200 feet in length, providing an effective head of 175 feet.

(*c*) *Dams and Retaining Walls.*—The scope of the present chapter is evidently too limited to deal with the subject of dams in a comprehensive manner. Therefore, the elementary features only can be considered.

The site for the power station having been selected, the next item is the location of the spillway, and finally its design. As a matter of fact, the spillway location may determine the site for the station rather than the station determining the spillway site. This case occurs more often in connection with direct developments for obvious reasons.

The chief factors to be observed in providing a dam are:

(1) The material to be used.
(2) Stability.
(3) Security against sliding.
(4) Permanency.

The first item, choice of material, must necessarily conform to the location in question. A timber and rock dam is not uncommon for the intake of a high-head development. Reinforced concrete is usual for the main dam and spillway of either direct or diversion developments of moderate head and large capacity.

It is of the highest importance to remember that the structural features must be worked out in detail. The construction of a dam is as important as its design, and the workmanship during its building is, after all, the final test of its true engineering qualities. The problem before the engineer is to design and construct the dams and retaining walls in accordance with the most economic placing of material for the purpose in view. In soils which are unsuitable to accommodate the weight of the dam in the proper manner, it is often necessary to provide piling in order to secure the dam to its foundation. In all such cases the foundation should extend from twenty to thirty per cent of the height of the dam, below the natural bed of the stream. Any possibility of the water entering beneath the dam must be prevented. Disastrous consequences have occurred from lack of attention to this important factor.

In designing dams and spillways the factor of safety to be used is more or less perplexing. It should never be less than two, and generally two and one-half to three, depending upon the likelihood of floods and their possible magnitude. Where logs, sticks, ice and other floating materials are carried down the stream it is evident that the stress upon the dam becomes abnormal and must be adequately provided for. It is true that the character of future floods cannot be foretold, yet a careful analysis of previous records of the locality in question will serve as a guide, and will do much to show the maximum

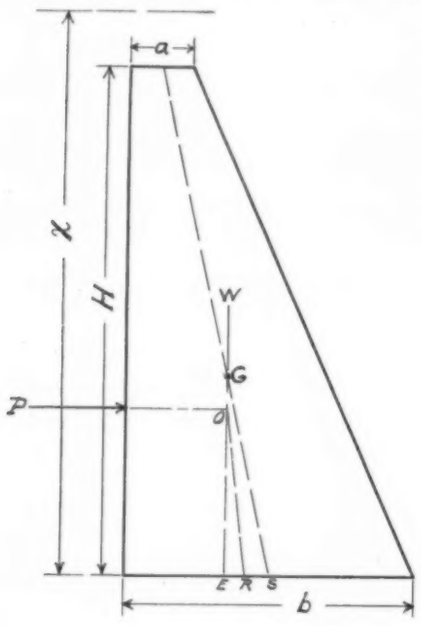


FIG. 1.

stress to which the dam is likely to be subjected.

Fig. 1 shows the principal stresses to be considered in a gravity dam or spillway having a trapezoidal cross-section. Let us assume first that the water level stands exactly even with the top. The center horizontal pressure will be located at two-thirds of the vertical distance below the top of the dam. If the water rises above the top, pouring over the slanted face, the point (or line of pressure) P will rise, so as to remain two-thirds below the water level, or $X = 2/3H$, where H is the total head. The vertical component W is made up of the weight of material composing the dam. To determinate the magnitude of the stresses find first the center of gravity G. The component W will be applied at this point. The value of P is determined for a unit length of the dam, say one foot, by multiplying the average hydrostatic pressure by the head or

$$P = H/2 \times 62.5$$

in which P = pounds horizontal pressure, 62.5 is the weight, in pounds, of one cubic foot of water, H = head in feet.

The resultant of the forces W and P should pass through the middle third of the base, in order to give sufficient stability to the dam. The width of base of the section should not be less than half the height, and will vary from this proportion to a value equal to the height or greater.

Where the stream has a high velocity, and underwashing is to be overcome it is not only good practice, but often necessary to provide a substantial filling on the up-stream side. Such procedure increases the stability and offers a high security against disaster from floods. Fig. 2 shows a section having a long width of base and a wide slope on the upstream side. The downstream side is

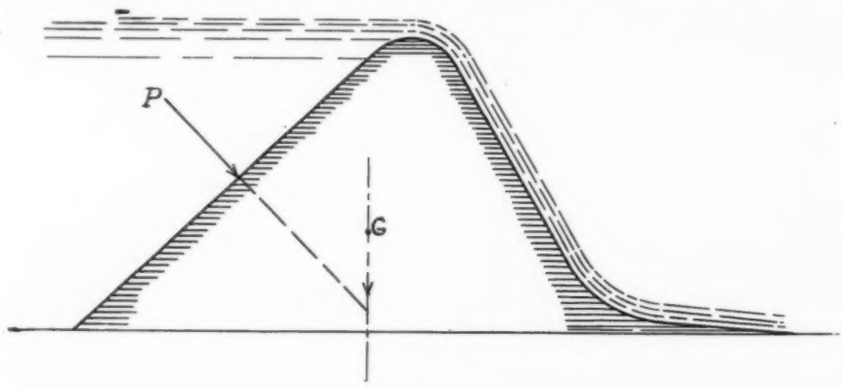


FIG. 2.

provided with an apron conforming to an ogee curve which minimizes the agitation due to the overflow. This form of apron is quite common, especially with large spillways. The accompanying photograph, Fig. 3, shows a reinforced-concrete spillway in process of construction. It is over 1,000 feet in length and is a good example of modern design.

Retaining walls and embankments for the purpose of holding water for storage are of as great a variety as that of spillways. The typical retaining wall is not subjected to the pressure of overflow, but nevertheless must be designed with proper consideration for stability, freedom from seepage, and economy of material used.

(*d*) *Headworks.*—The headworks of a hydroelectric plant embrace the intake, or upper forebay, with its retaining walls, spillways, headgates, and mechanical appliances for operating. In many cases a portion of the flumes or pipe lines leading to the power station are included.

High-head developments, those of several hundred feet in connection with mountain streams, should have suitably constructed sand boxes for the purpose of eliminating sand and silt which are erosive, and cause more or less violent cutting of the power portions of piping, nozzles, and turbine buckets. In this connection the writer has been interested in studying some of the high-head plants on the Pacific coast, both in Washington and in southern California. Observation seems to indicate that the frequent rains in the North prevent thorough settling of the sand by keeping it agitated; hence a considerable quantity of sand is carried through the nozzles, producing erosion, which demands rather frequent renewal of nozzles and buckets. In southern California where dry weather prevails the quantity of sand and silt carried over is greatly reduced, and erosion comparatively slight. One plant in this locality which has an effective head of nearly 2,000 feet showed on inspection that one of the impulse wheels had been operating about seven years without any renewal of buckets. Several of these buckets displayed the effect of erosion to the extent of being worn nearly through the concave surfaces. However, the general appearance was remarkable considering the amount of service rendered. In a similar plant in the state of Washington, in which the head was only one-third as great, renewals were required more than twice as often. These facts serve to show that the nature of the locality is of vital importance, and deserves close study in order to provide for efficient working of the plant after it is installed.

The accompanying photograph, Fig. 4, shows the headworks of a power development in California which operates under a head of 760 feet. It clearly shows the pipe line on the right which leads to a tunnel at the end of which the forebay is located.

Starting with the headwaters we have first to consider the manner of conducting the water to the pipe lines, or penstocks, as the case may be. Suitable screens or racks must be provided which will keep out driftwood and other floating material. The intake (or forebay) is preferably inclosed with concrete or masonry walls.

Where sand boxes (or equivalent settling basins) are required, as they are in high-head developments, they may be constructed of wood or concrete. In form they consist of a series of tanks or hoppers, sloped at the bottom so that the sand, gravel and silt will drop to the lowest level and can be eliminated by flushing. One main tank with a series of labyrinths may be used instead of several individual boxes. The details of construction will depend for the most part on local surroundings.

There are two general methods used in shutting off the water from the pipe lines. By means of headgates or with stop-logs. The former method is generally employed. The gates may be operated by hand or by motors. In large developments, either direct or distant diversion, motor-operated gates are generally used. Stop-logs are a means of conveniently shutting off water from one of a large number of penstocks for the purpose of making repairs.

(To be continued.)

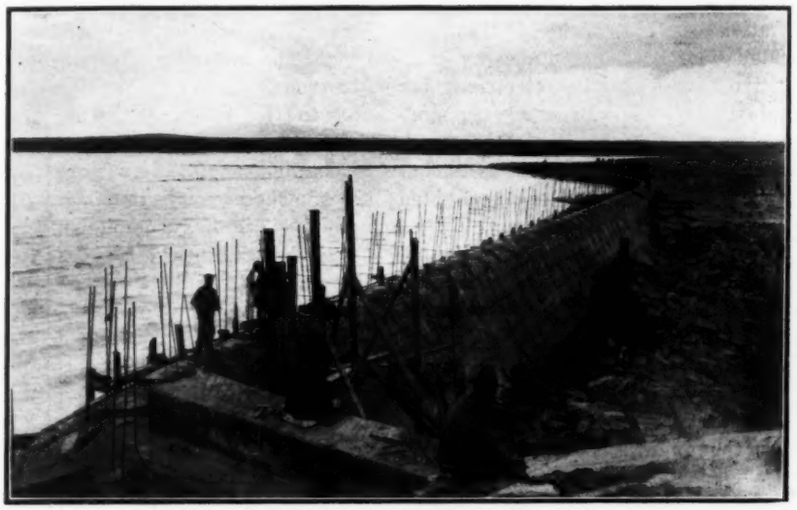


FIG. 3.—REINFORCED CONCRETE DAM AND SPILLWAY.

FIG. 4.—DAM AND PIPE LINE AT HEADWORKS.

New Electric Equipment for Panama.

The present electrical generating equipment of the power and air-compressing plant at East Balboa, Canal Zone, is to be replaced by a 500-kilowatt, low-pressure, turbo-generator. The main engine shaft at the plant broke on January 1, placing the larger of the two alternating-current generators out of commission, and curtailing the production of current for lighting purposes. The East Balboa plant has been supplying alternating current for day and night lighting in Ancon, Balboa, and East Balboa, and direct current for the operation of the cranes on the Panama Railroad wharf and for the motors in the Pacific Division machine shop at Balboa. The new generator will be of the 2200-volt, three phase, twenty-five-cycle type, and its installation will necessitate the substitution of the present direct-current motors on the wharf, and in the machine shop, with 220-volt, three-phase, twenty-five-cycle motors.

The committee which had the matter in charge, considered the feasibility of furnishing all current in the area between Balboa and Pedro Miguel from the Miraflores plant, but the determination was reached that the latter could not safely assume the extra day load without danger of interruption to the work in the Pacific Division. Under the new arrangement, the Balboa and Miraflores plants will be operated in parallel; the Balboa plant will carry its present day load, operating under power furnished by the exhaust steam of the air compressors, which will not only constitute a fuel economy but will obviate any necessity for additional boiler capacity; while the Miraflores plant will assume the night load. In addition to the electric current required at Balboa during the day, there is sufficient energy in the exhaust steam to furnish from 100 to 200 kilowatts to the system now operated by the Miraflores plant.

Magnetism in Manganese.

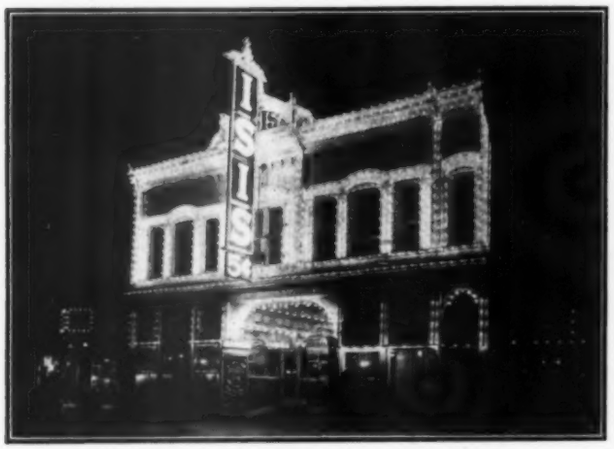
The researches of Weiss and Onnes have shown that pure manganese can exist in two states, one of which is paramagnetic and one ferromagnetic. The latter exhibits hyteresis. This metal, vanadium and chromium show little magnetism at low temperatures, but the magnetization of iron, nickel and magnetite is increased.

ELECTRICAL Advertising *and* Selling

ILLUMINATION OF DENVER'S MOVING-PICTURE THEATERS.

BY JOSEPH A. McMEEL.

Two illustrations that prove the drawing power of light and which are in keeping with the "moth and flame" axiom are the lighting effects on two of Denver's five-cent moving-picture theaters. These amusement houses are the largest of their kind in the city, their display lighting features are the largest and the daily average attendance is by far the greatest, it being in the neighborhood of 14,000 daily. The managers of each are emphatic in their belief that the lavish use of electricity for display purposes—exterior and lobby—is directly responsible for the capacity houses they show to at every performance. Their declarations might be substantiated by mentioning that about 12,000 of these people attend the shows in the evening hours. It is therefore obvious that the lighting facilities play an important part in attracting the people. At any rate the managers of the Isis and Iris Theaters appreciate the value of their displays and have expressed their belief in the worth of this method of advertising by large additions of lamps at different intervals.



EXTERIOR ILLUMINATION OF ISIS THEATER.

ILLUMINATION OF ISIS LOBBY.

A significant fact that speaks volumes for the magnetism of this illumination is that each of the well-lighted houses is surrounded by competitive houses that use electricity for display purposes only in a very moderate form. In every case the attendance at the Isis and Iris surpasses that of the competitive and dimly lighted houses by about three to one. When it is seen that the brilliantly lighted houses gathers the bulk of the theater-goers after dark it must be acknowledged that profuse exterior illumination does something other than illuminate the streets in front of the theater—it attracts the crowds.

Another influence that stimulates the attendance at these two play houses is their location. They are situated on Curtis Street, the best lighted thoroughfare in the city. Almost all the illumination on this street is supplied from individual sources. The electric signs, window lighting and outlining effects on the establishments of the different merchants contribute almost the entire volume of light.

It might be well to give some idea of the combined magnitude of the lighting power in this territory and its general effect on attracting the crowds to this thoroughfare in the evening hours. From Fourteenth Street as the western end of this "White Way" and Eighteenth Street as its eastern terminus there are a total of forty electric signs. Each is of separate and distinct type. The outlining effects are not so numerous, but are frequent enough to add to the brilliance. The window-lighting effects, however, are of a corresponding magnitude with that of the signs. These effects together with the municipal lighting combine in making Curtis Street one of the best lighted thoroughfares in the country. It is literally the "White Way" of Denver.

In regard to the lights being responsible for the enormous night traffic in this vicinity, an idea of its extensiveness might be gleaned from the count taken by the Denver Gas & Electric Company in October, 1909, which shows the pedestrian travel on this street to be the heaviest in the city. The count indicated the number of people on foot, the number of street-car passengers, the number of vehicle passengers, including those on bicycles, and the number of street cars and vehicles, and is substantially correct.

The first mentioned count—that of the pedestrians on foot—is the only one that has any real bearing on the attendance at these two theaters, assuming that only a small percentage of the vehicle and street-car passengers stop along this thoroughfare, and for that reason we will consider it only. The total number of people passing

Sixteenth and Curtis Streets the night of the count was 96,643. East of Sixteenth Street in the immediate vicinity of the two theaters in question the exact number of people was 16,900. Here it might be cited, however, that some of the people coming into Curtis street from Seventeenth and Eighteenth Streets, but not proceeding as far west as the counters, stationed at Sixteenth and Curtis Streets, were not included in the recapitulation. A conservative estimate of this number might be taken at about 6,000 people. This number makes a total of 22,900 people directly in the path of the attractive light from these theater fronts.

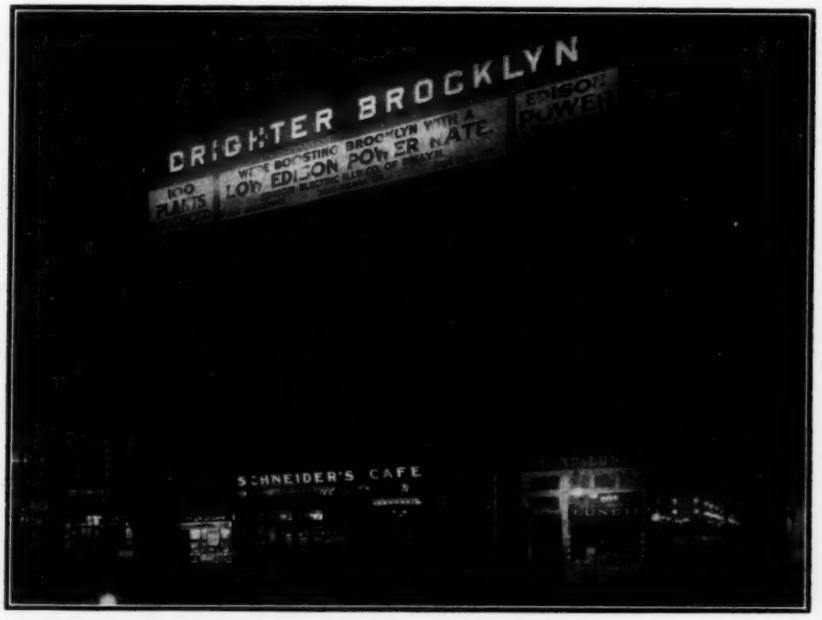
Similar statistics were taken in other down-town sections of Denver, but almost all were taken in districts illuminated on a smaller scale and, as might be surmised, the pedestrian travel in every instance was much lighter. The enumerations were taken on different nights and at times when just the ordinary street crowds were about. This, therefore, certifies that this same average holds good throughout the year.

In the center of this intensely lighted and much traveled thoroughfare are the Isis and Iris Theaters. From the large number of people passing along Curtis Street nightly they attract 12,000 through the use of lavish display lighting. This is a fraction over fifty-two per cent of the total number of pedestrians that travel this street. The rest is distributed between two popular-priced vaudeville houses, four competitive moving-picture establishments and several pool rooms. In the case of the vaudeville houses and pool rooms they attract simply because they offer a variety. With the moving-picture houses, however, the people flock to the one presenting the most prosperous appearance in the hope of seeing the best performance. The brilliantly lighted exterior is naturally suggestive of prosperity and therefore attracts more people. One manager asserts that he receives a net income of $100 a day.

The display-lighting equipment of these theaters consists of two different types strictly up-to-date. The Isis is illuminated by 22,271 four-candlepower carbon lamps, equipped with Holophane shades. Besides this lighting, vacuum cleaners are installed throughout. Thirty-four electric fans are used for ventilating purposes, which condition is approved by the Denver Board of Health. There is also a three-horsepower exhaust fan which aids in keeping the atmosphere pure.

On the Iris an entirely different form of illumination is used. The lamps are almost entirely tungsten, equipped with the Holophane glassware. In the canopy which extends out over the sidewalk there are four 250-watt, thirty-five 60-watt, fifty-three 100-watt tungsten lamps and 301 four-candlepower carbon lamps. Colored lamps are used in all the lighting effects. The Iris also has installed twenty electric fans and a three-horsepower exhaust fan for ventilation. In the summer it is considered the coolest theater in Denver. Vacuum cleaners are also used in this house.

ILLUMINATION OF IRIS THEATER.



NIGHT VIEW OF BROOKLYN ADVERTISING SIGN.

Boosting Brooklyn.

In the accompanying illustration is shown a new and effective combination electric sign and bill board erected opposite the Long Island Railroad depot, which is today the busiest center of traffic in Brooklyn, N. Y.

The sign is eighty feet long; the electric letters are three feet high and the billboard is nine feet high. It is contemplated to change the lettering on the billboard once a month.

This is the first of a series of such display advertisements which the Edison Electric Illuminating Company of Brooklyn will erect throughout Brooklyn.

Souvenir Advertising.

The Toronto Electric Light Company, Limited, Toronto, Canada, is distributing among its customers a serviceable souvenir in the form of a horse-shoe key tag and chain.

Central Station Buys Electrics.

The Edison Electric Illuminating Company, of Boston, has purchased during the past twelve months twenty-three electric vehicles of various types and sizes.

Spectacular Sign for Louisville.

In this day of striking electrical display signs, it is unusual for signs of extraordinary size to combine as many unique and original effects as are shown in this mammoth display sign at Louisville, Ky., erected in Federal Park, where by actual count 20,000 people pass every night between the hours of five and eleven. It is the most conspicuous object in the city.

The huge steel frame work of this sign is 100 feet long and towers 60 feet into the air above the surrounding building. At each end is a massive Corinthian pillar forty feet in height, surmounted by a huge ball of wrought iron and art glass four feet in diameter. The sign is divided into six rectangular display spaces, each measuring 20 by 30 feet, upon which are built the various advertising displays. Over the sign the word "Louisville" is shown in huge letters.

The illumination is accomplished by means of 5,503 lamps, and the color effects are startling in their beauty and effectiveness. Except for a few red lamps at the base and in the scroll in the capital, the two pillars are a blaze of white light, supporting the beautifully colored art-glass balls which are lighted from the interior. The word "Louisville" and the strip lighting separating the panels are outlined in white light.

The Montenegro-Rheim Company's display shows a pianist playing a grand piano, operated by a flasher which causes the player's hands to apparently move up and down the key-board of the piano and her body to assume different positions. The piano and stool are shown in red and the key-board in white, while the lady's gown is white, her face and arms illuminated by amber lamps and her hair a very dark red. The lettering is all white.

The street car is the most realistic moving effect on the sign and rivals in cleverness the famous chariot race sign in New York. The wheels of the car outlined in blue lamps revolve forward, and the track outlined in white apparently moves backward. Apparently the car is rushing forward at full speed, with its headlight (lighted by a 100-watt tungsten lamp), and the sparking trolley wheel adding to the realness of the effect. Suddenly a gong rings twice, and the trolley stops sparking, and the wheels cease revolving and the car stops.

The appeal to both eye and ear makes this a most realistic electrical effect. The body of the car is green, the top red, the trucks and fender blue, and the wheels and track are painted white.

The upper right hand panel is an attractive sign in red and white lamps. Below it the florists's sign displays in natural colors a gorgeous bunch of American Beauty roses operated by a flasher so that the stems and buds appear to grown into full blown roses under your very eyes while the ribbon is made to flutter as in a breeze.

The sign directly under the street car shows two bare-footed children drawing a cart loaded with toy furniture. A flasher makes the little figures seem to walk, while the revolving wheel of the little wagon and the backward motion of the road way completes the delusion of progress. The cart and furniture are painted in natural colors and lighted with white lamps. The children's hats are red, the dress and trousers blue and the feet are lighted with amber-colored lamps.

ELECTRIC SIGN FOR LOUISVILLE.

This sign has been the cause of much comment in Louisville and has had great advertising value. The space was entirely sold before the sign was completed and the advertisers have had reason to be proud of their foresight. The sign was constructed by the Federal (Electric) Sign System, of Chicago, Ill.

Electric Tower Wagon.

In the current *Bulletin* of the Philadelphia Electric Company, a house organ which is devoted to the boosting of electricity in Philadelphia, there appears a description of the new electric lamp-trimming wagons recently adopted by the company.

The bulletin states that the necessity for greater efficiency and economy resulted in the development of the electric power wagons. The problem was to design a vehicle which could be operated by one man with ease and dispatch, and at the same time have this man do the work of the lamp trimmer. The tower wagon, which is the result, is a triumph from the standpoint of electric control. A gasoline vehicle would have presented insurmountable difficulties.

The tower wagon is constructed on the ordinary 500-pound chassis, the weight of which, with the tower is 3,250 pounds. The vehicle is equipped with a forty-two cell, seven-plate storage battery, which will furnish an average speed of fifteen miles per hour on the level. The vehicle can be operated from the ordinary seat or from a platform on a level with the lamps.

Under the old method it required approximately nine hours to trim each lamp route, but with the tower wagon this is accomplished in approximately six hours. In addition to the saving realized by the company over the former method of trimming, the wagons are effective arguments for electric vehicles which the public has an opportunity of seeing demonstrated.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

ELECTRIC STREET LIGHTING.—II.

BY ALBERT SCHEIBLE.

OPEN ARC LAMPS IN STREET LIGHTING.

One of the characteristics of arc lamps which stood out strongly in the early days of electric lighting, was the effectiveness with which these lamps lent themselves to police duty, the light being powerful enough to penetrate into distant nooks. This police function of street lights had been recognized long before that period; indeed, as much as fifty years ago, the control of public lighting was in the hands of the prefect of police. But the gas lamps as used twenty-five years ago were quite limited in their power of penetration, which was emphasized in the arc lamps by fitting them with clear glass globes.

The great superiority of electric over gas lamps had been demonstrated by the so-called "Jablochkoff candle," which, as an arc lamp without a feeding mechanism, was the forerunner of the open arc lamp in both commercial and street lighting. The introduction of these Jablochkoff lamps at the Holborn Viaduct, in London, in November, 1878, (where sixteen of them replaced and far outshone eighty-six gas lamps), and later at the Paris Exposition of 1879 showed what effects could be obtained by the use of more intense lighting units and paved the way for the more practical lamps of Brush and others.

The rapid extension of street lights to the entire city required that the lamps have greater intensity and penetration which immediately gave the arc lamp a tremendous advantage over the older illuminants.

For a time there was an interesting rivalry between the so-called "long arcs", requiring close to fifty volts at the arc and the "short arcs," burning at about thirty-five volts with larger amperage for the same candlepower. The frequent flaming and flaring of the former was offset by the hissing of the latter, but the smaller wires required for the long arcs gradually gave them the supremacy. These lamps were first offered in various candlepowers for use on circuits of correspondingly varied current strength, such as:

Candlepower.	Amperes.
3000	15
2000	10
1200	6.8
1000	5

In time the ten-ampere (or more often 9.6-ampere) lamp became the more common standard, though in this country street-lighting contracts commonly designated them not by their current and voltage, but as "standard 2,000-candlepower arc lamps," thereby offering the chance for serious dispute with the contracting municipalities. Owing to the growing number and seriousness of the misunderstandings due to this absurd lamp rating, the American delegates at the International Electrical Congress of 1893, asked this congress to define a 2,000-candlepower lamp as one operated at 450 volts; but the delegates from other nations declared that they never made contracts in candlepower and declined to join in any such vote.

A year later the National Electric Light Association undertook to define a 2,000-candlepower arc lamp as "one requiring on the average 450 watts for its maintenance, the measurement being made at the lamp terminals exclusive of resistance." When this was adopted those present were familiar only with the series direct-current lamps and the resolution aimed to fix a standard, viz., the amount of light delivered by a certain type of lamp at a certain wattage, as the unit for street lighting contracts. This definition was substantially confirmed in the celebrated Colorado Springs electric light controversy of 1907, where the arbitrators admitted that in September, 1898, no arc light in use for street-lighting purposes was of 2,000-candlepower, but that this term commonly designated a direct, constant current, series, open arc lamp taking 9.6 amperes and consuming 450 watts at the arc.

Fortunately for the electric light interests, the need of a proper designation for street arc lamps was strongly felt by the time the series alternating arcs were introduced, so that contracts for these were no longer based on an alleged candlepower. Subterfuges, like the one quoted by Professor Shepardson that a corner lamp sending 500 candlepower down each of the four streets might be considered as having 2,000 candlepower, had failed and the electrical fraternity was glad when a change of lamps offered an escape from more of these costly misunderstandings.

But it was not only the frequency of such disputes, nor even the saving in trimmers' time that led the series alternating arc to crowd out the open arcs; nor was it the poorer distribution of the light, though this was commonly emphasized by the central-station men when persuading city councils to contract for light from the new lamps. Owing to the long arc travel of the open arc lamps, the use of reflectors was out of the question and no attempt was made to improve the distribution of the light which was most intense at an angle of about forty-five degrees below the horizontal and which usually cast heavy shadows of the globe-holder and lamp frame. With alternating arcs the light distribution was much worse, as half of the light would be sent upwards, hence these did not come into general use until the adoption of inclosing globes allowed the arc travel to be greatly reduced. Steadiness of the light was a rarity, though the flickering was not due as largely to faulty mechanisms as was generally assumed at that time. Speaking before the American Institute of Electrical Engineers in May, 1890, L. B. Marks showed that the prevailing irregularities in the action of arc lamps were due more to unsuitableness of the carbon than to defects in the lamp mechanism or fluctuations in the current and voltage on the line. From that time on, carbons were steadily im-

proved and the introduction of the inclosing globes crowded out the double-carbon arc lamps formerly required for all-night lighting.

In the Colorado Springs controversy it was clearly brought out that the standard open arc lamps were more efficient as light producers than the inclosed arcs which succeeded them, and that with equal improvements in carbons and mechanism they might be quite as steady. The real limitation to their use lay not in the lamps themselves, but in the voltage then practical for a single circuit or generator. For, with the safe capacity of an arc-light dynamo, limited to about 3,000 volts, it took a large number of these "fifty lighters" to supply the street-lighting current for a city of any size, and to save wire, this meant numerous scattered central stations in each large city. As one writer remarked: "If ever there was a type of dynamo that stood for individualism and for independent service on a small scale, it has been the series arc generator." Even when built in multi-circuit types, the arc generators did not grow above 100 kilowatts capacity, while other types ranged into the thousands of kilowatts. Only the poorer luminous efficiency of the series alternating arcs enabled the old direct-current arc generators to hold out for years after incandescent generators had reached the large direct-connected sizes which saved floor space, friction losses and cost of attendance. Then when the self-regulating constant-current transformer (popularly introduced as "tub" systems), were evolved, enabling arcs to be grouped on comparatively short circuits and yet economically supplied with current from a single large generator, the resulting economies in central-station operation and distribution forced the series arcs into use at a surprising pace. Thus it was the limitations of the generators and the distribution systems, rather than those of the lamps themselves, that forced the open arc lamps from their original supremacy in the field of electric street lighting.

INCLOSED ARCS IN STREET LIGHTING.

While it was known early in the history of arc lighting (in 1879) that sealing the globe to exclude air would lengthen the life of the carbons, it was long before carbons were found which would not speedily coat the inclosing globes with a heavy deposit. With the perfecting of purer carbons, the inclosing globes returned in improved form in 1890, became commercial in 1894 and by 1897 were being used with both direct-current and alternating-current arc lamps, reflectors being used with the latter. For while the intensity of the light in the maximum direction was only about 550 candlepower for the 7.5-ampere alternating inclosed arc, as against 1,250 for the 9.6-ampere open arc, the shortening of the arc travel by the partial vacuum of the inclosing globe permitted the use of reflectors for effectively distributing the light. Consequently, the lower wattage and lower candlepower still meant a higher illumination at distances from each lamp of 110 feet or over and in street lighting this distribution of the light to distant points is an important factor.

The more uniform distribution of the light thus obtained by having more of it sent out within an angle of ten degrees below the horizontal, the absence of marked shadows of the carbons or lamp frame, as also the greater steadiness of the new and simplified lamps formed valid reasons for the change from open arcs to the inclosed. Moreover, the frosted or opalescent inner globes distributed the apparent source of the light over a considerable surface, making the glare of the light when in the range of vision much less objectionable than with the open arc lamps. Incidentally, their introduction meant a saving in the labor of trimming and more than all else, the possibility of substituting large central-station units and high-voltage distribution circuits for the multitude of small arc dynamos and their little independent circuits. The coming of the constant-current transformer, first introduced at Hartford, allowed the alternating-current inclosed arcs to be used in series with a great saving in the costs of distribution and of central-station attendance, as these 50, 100 or 150-light "tub transformers" could be connected directly to the busses of the same direct-connected units which were so rapidly growing in size and general utility.

This use of constant-current transformers for supplying current to street arcs from large generators, as first described before the National Electric Light Association in May, 1900, by W. L. Robb, spread so rapidly that a year later about 125,000 alternating arcs were in service, most of them being 6.6-ampere, 430-watt (average) lamps. By May, 1902, they had been adopted for street lighting by some 300 cities, while only about fifty were still using direct-current series arcs together with about 20,000 direct-current inclosed arcs.

In justifying the change by emphasizing the better distribution of the light, there was a tendency in many cities to use more closely spaced lamps of lower candlepower, such as the four-ampere alternating arcs (of 275 to 300 watts) of which the first large installation was at Cincinnati. This movement towards a closer spacing of the street lamps meant a departure from the prevailing plan of having lamps only at corners (and often only at alternate ones), the influence of which is still strongly felt.

(To be continued.)

The Price of Copper.

According to figures given in *Copper Gossip* there is a considerable overproduction of copper at present, and some companies are actually placing it on the market at an absolute loss to themselves. In many cases the companies continue to lose money as if the achievement of showing a deficit each year was something to be proud of. As an illustration of this peculiar system of management is mentioned the case of one company which produced during the last three years a total of 37,402,940 pounds of copper at a loss from operations, according to its own reports, of $400,586.47. During the last five years the total cost of production to this company has fluctuated between 14.3 cents and 16.6 cents per pound. The present price of copper on the New York market is 12.5 cents.

Electricity and Gas for Street Lighting.

The Manchester City Council has agreed that a test shall be made of the comparative cost and efficiency of street lighting by means of high-pressure gas and electric current.

Mexican Rubber Trade Hindered.

Owing to unsettled conditions caused by the revolution in Mexico, the output of crude guayule rubber has been materially reduced. All the factories are short handed and the producing companies are experiencing a great deal of difficulty in finding cars to move their product. D.

TELEPHONY—TELEGRAPHY, *and* WIRELESS.

River Wireless Telegraphy.

Some interesting experiments in what may be called river wireless telegraphy were described in a recent issue of *Indian Industries and Power* by H. Rahman Khan, Deputy Superintendent of Telegraphs, Allahabad. The results of these experiments prove the usefulness of rivers as a means of signaling between distant stations situated in close proximity to them.

In an interesting pamphlet on the subject, Rahman Khan details the course of his experiments which were made in the year 1908, when telegraphic communication between India and Chitral had been interrupted for some days, due to the breaking of a telegraph line.

The system, however, is hardly one of wireless telegraphy in the sense of telegraphy by means of Hertzian waves. It is rather conductive telegraphy through an imperfect conductor by means of vibratory currents to which the receiving telephone is very sensitive.

Society of Wireless Telegraph Engineers.

At the annual meeting and banquet of the society on February 27, at the Hotel Lenox, Boston, the following officers were elected for the coming year: President, Fritz Lowrenstein; vice-president, Louis Cohen; secretary, E. B. Moore, 39 Trinity Place, Boston; treasurer, V. F. Greaves; directors, Samuel Cabot, F. H. Knowlton and George Hill.

Railway Telegraph Superintendents.

The next annual convention of the Association of Railway Telegraph Superintendents will be held in Boston, Mass., June 19 to 23, inclusive. Special efforts are being made to provide an unusually complete series of entertainment features as it is expected that the convention will be very well attended.

SIGNALING ON RAILWAYS[1]

BY FRANCIS G. BOYD.

In few other branches of equipment has a greater advance been made than in signalling, the reasons for this advance being the increasing call for expeditious movements of traffic while preserving absolute safety in working.

Between the original "time" signaling methods and the subsequent application of "space" signaling, followed by the grouping of levers and the introduction of interlocking and other precautionary measures, the improvements made in the mechanical branch of the work have been many and of great import, while the adaptation of electricity as a control on the mechanical working has done much to complete the march of progress, with the result that although British railways are in some quarters reproached as being the most expensively signaled lines in existence, yet they also hold the more satisfactory position of being the safest lines of transport in the world.

Although mechanical signaling has been brought to a high state of perfection, and for all ordinary purposes probably forms the cheapest type of control, both as regards first cost and future maintenance, yet, like all manual-worked appliances, it has had to give way under exceptional circumstances to power-worked plants, of which several varying descriptions have been brought into practical use during recent years, and among which the following may be noted.

Westinghouse Electro-pneumatic System.—In this system the signals, points, bars and locks are operated by motors worked by compressed air at a pressure of from sixty to seventy pounds per square inch, the valves of the motors being opened and closed by electric circuits controlled from the signal box. A special feature of the system is that, in the case of levers working points, the full movement of the lever is not at once obtained, a lock on the lever arresting the full stroke. The initial movement only sets up the electric circuit which admits the compressed air to the motor and when this has been done another circuit conveys the return indication of the movement to the box, releases the lock on the lever, and permits it to be pulled fully over the complete operation taking only two seconds to accomplish. A similar procedure is followed when restoring a signal lever to a normal position in the frame, the movement not being completed until the return indication proves that the arm has properly assumed the danger position. These precautions eliminate all risk of failures of points or signals occurring without being detected, as in case of any movement being either partially or altogether impeded, the lever controlling the movement, and all other levers dependent on it, are immediately locked up, and continue locked until the impediment is removed. A good instance of the practical working of this system may be cited at the Glasgow Central Station of the Caledonian Railway Company, where one signal box, containing 374 levers, controls the whole of the station.

The Siemens "All-Electric" System.—In this system the operation of points and signals is effected by electrically worked motors controlled by switches forming part of the locking frame and connected thereto by suitable cables. The mechanism for working points consists of a reversing motor, driving, through worm gear and a friction clutch, a shaft which carries a crank. In the case of trailing points the crank has an angular movement of about 150 degrees and is coupled direct to the tongues. The worm gear securely holds the points in either po-

[1] Abstracted from the presidential address recently delivered before the Society of Engineers, London, Eng.

sition, but the friction clutch allows them to be run through without damage to the connections, and should the points become jammed by stones, etc., during the movement, allows the motor to revolve, but without sending the return current to withdraw the check lock. For facing points, provided with locking bar and bolt, the crank has a movement of 320 degrees, and is coupled by a special rotary escape-crank arrangement with both the bar and the points, the movements being as follows. As the crank revolves the bar is first lifted, which in turn withdraws the bolt; the latter, however, is not clear of the stretcher rod until the bar has passed the middle position. Movement is then given to the points by the escape crank. The bar has meanwhile commenced its return stroke, and the bolt enters the hole in the stretcher rod when the points are home. The motor circuit is automatically opened on the completion of each movement, the current being shunted through the detector contacts back to the cabin to operate the check lock. The current required for working an ordinary pair of points of the heaviest rail section, together with facing point lock and bar, averages four amperes at 130 volts, the time taken for the complete movement being two to three seconds.

The semaphore signals are worked by a motor attached to the back of the post. The motor revolves a coupling magnet through a worm which gears into teeth formed on the magnet casting. The current received from the cabin passes through the coupling magnet, in shunt with which is the motor having in its circuit a quick-break switch. The magnet, being energized, forms with its armature a magnetic clutch, thereby coupling the motor, through the worm gearing and pinion, to the signal arm. The motor, revolving, lowers the semaphore to a predetermined angle, at which point its circuit is opened by a switch. Its motion being arrested, but the magnet being still energized, the arm is held in the "off" position until the main circuit is opened. The signal then returns to danger by gravity, a contact giving a return indication to the cabin. A special safety device prevents the arm being lowered either accidentally or willfully.

The current for working a signal averages two amperes during the movement, which takes one and one-half seconds. The motor is then automatically cut out and the signal held off by the coupling magnet with a current of one-quarter ampere until the lever is replaced in the frame. The locking frame is complete in itself, merely requiring to stand on the cabin floor, through which the cables to the points and signals have to pass. The height of the frame does not exceed four feet, and the width twelve and one-half inches, the total weight being forty pounds per lever. The system is being installed at the new Great Western Railroad Station at Snow Hill, Birmingham, where 300 levers will eventually be working, of which 124 levers have been in use for the past year.

Sykes' Electro-mechanical System.—In this system the points are mechanically worked by levers grouped in a frame of the ordinary pattern, the signals being electrically operated by small slides placed immediately over the frame in the signal box. The system has been installed at St. Enoch Station, Glasgow, where 715 electrical slides are in use; at Victoria Station, London, where 377 slides have been fitted; and at Folkestone and St. John's to Orpington, where 277 slides are fixed. The semaphore signals are actuated by motors, and the shunting signals by electric coils.

Automatic Signaling on the London Underground Railways.—This system of signaling, which has played so important a part in the success attending the electrification of the old steam-worked Metropolitan District Railway, was also perfected and installed by the Westinghouse Company, and enables a service of forty trains per hour to be maintained with commendable regularity.

Under this system, the automatically worked portions of the lines are divided into sections varying from 900 to 4,000 feet in length by a special arrangement of track circuits, one of the running rails being divided into block sections by means of insulated fish plates, while the other rail is electrically continuous. A potential of from two to four volts is maintained between these two rails. At each end of a block section, a polarized relay is connected by one terminal to the block rail, and by the other terminal to the continuously bonded rail. The local signal circuit is controlled by both relays, and unless both are suitably energized by a current in the normal direction, the signal cannot drop to clear. The entrance of a vehicle into the block section short-circuits one or both of the relays and the signal is placed at danger, and remains there as long as the section is occupied.

The chief feature of this system is that currents extraneous to the signal system cannot affect the apparatus so as to cause a false indication of safety. When a train is in the section, one or other of the relays is always reversely energized or shunted, thus opening the local signal circuit at one or two points.

Each signal is governed by the section next in advance, and this section commences 400 feet beyond the signal, and extends to a similar distance beyond the next signal. This length of 400 feet is known as the "overlap" and a signal cannot be lowered until the whole of the preceding train has gone out of the section in advance, and has also passed the next signal by the length of the "overlap." This arrangement guards against a collision resulting through a signal being passed at danger, and a further safeguard is given by the automatic train-stops which apply the continuous brakes if a train passes a danger signal.

Audible Signaling—The Driver's Cab Signal.—This invention is the outcome of an attempt on the part of several experienced railway officers to produce a signal of a reliable character which would inform the driver of a locomotive of the position of the stop-signals ahead of him, when atmospheric conditions render it difficult, and sometimes impossible, for a sight of the semaphore arm to be obtained.

Since the inception of the idea, however, the scope of the invention has widened, and it is now found not only possible, but desirable, to make the driver's cab signal a substitute for the distant signal. The apparatus can also be fixed in tunnels, where an ordinary signal could not be placed, and could be used as a warning signal for temporary or permanent speed slacks.

At each point where it is desired to give an audible signal, an insulated ramp, consisting of a bar of T-iron from forty to sixty feet long, is fixed into the center of the four-foot way. The center length of the bar is fixed at

a height of four inches above rail level, the ends sloping off in either direction.

On each engine is placed a shoe, which normally stands two and one-half inches above rail level, and which, on engaging with the ramp, is raised to the extent of one and one-half inches. The shoe is insulated from the mass of the engine and, in its normal position, serves to complete an electric circuit, but when it is raised, by passing over the ramp, this circuit is broken, and a steam whistle liberated, thus giving the driver an audible "danger" or "warning" signal.

If the signalman desires to convey an "all right" or "clear" signal, a current is passed from the signal box to the ramp which completes an alternative circuit on the engine, prevents the whistle being liberated and, instead thereof, rings an electric bell, thus giving an audible "clear" signal. Visual indications are also given in the engine cab corresponding with the audible signals.

For single-line working a special arrangement is used whereby the signalman is compelled by the interlocking to cancel or neutralize the ramp not applying to the direction in which a train is traveling, by withdrawing an electric staff or tablet from the instrument; and, when the staff has been withdrawn, the special lever for canceling the ramp is back-locked until the staff has been restored at one end or the other. The system has been introduced on the Great Western Railway.

Track Circuits.—Recent events have unhappily brought into prominence the liability of the human element in signal operations to err, when movements are not actually controlled by mechanical agencies, and a brief reference may perhaps be made to the advantages obtained by installing track circuits at spots where special protection is required.

At stations, where a clear view of all the roads is not possible from the signal box, or at large depots, where shunting operations have to be carried out in conjunction with the ordinary traffic, the provision of track circuits prevents the presence of a train or vehicle on any line so treated being temporarily overlooked or the admission under block working of another train into the section.

At junctions, or other spots where lines cross or foul one another, the provision of circuiting automatically effects a safe measure of control over all movements, and where short sections occur, which preclude the erection of advance signals, the extension of the circuit for a short distance beyond the junction gives an overlap, or safety length, which must be passed by the last carriage of train before the signalman can plunge back and accept another train.

Telephone Pioneers of America.

Efforts are being made to organize an association of the early and steady workers in the telephone field to be known as the Telephone Pioneers of America. Over eighty men have signified a desire to join such an organization. A requisite for membership is continuous employment in the telephone industry for twenty-five years prior to application. Applications should be sent to Henry W. Pope, of the American Telephone & Telegraph Company, 15 Dey Street, New York.

The Corrosion of Brass and Copper.

In a paper which was read before the Liverpool Engineering Society by G. D. Bengough, and which is reprinted in the *Times Engineering Supplement* (London), the results of a careful investigation of the corrosion of brass and copper, especially in connection with sea water, are quite fully set forth.

The whole trend of modern work on corrosion goes to show that for any metal or alloy to undergo continuous solution or corrosion it is necessary that there should be present in and around it substances capable of forming among themselves little voltaic cells. This means that if corrosion is to take place there must be on the surface of the metal (1) an area capable of acting as an anode, or dissolving pole; (2) a liquid capable of acting as an electrolyte; and (3) an area capable of acting as cathode. In the case of an ordinary metal tube, through which sea water was passing, probably the bulk of the metal could act as anode, and the sea water provided the electrolyte; the interesting point to be considered is what would act as the cathode and complete the cell. The following materials had been stated, at one time or another, to promote the corrosion of brass or copper by acting as cathodes: lead, copper, arsenide, green basic carbonate of copper, ferric oxide, metallic nickel, carbon, cuprous oxide, and seaweed.

The effect of stray currents on the speed of corrosion, again, is a point on which great divergence of opinion exists. There appears to be a great body of opinion amongst engineers that leakage from electric-light mains is a prolific cause of the corrosion of condenser tubes, and one great argument that can be put forward in favor of this view is the fact that corrosion gives greatly increased trouble very soon after the introduction of electric lighting on board ship.

Many attempts have been made to find a suitable coating to protect tubes and metallic fittings from contact with sea water. Among purely mechanical protectors, such materials as varnishes, asphalt, and special forms of cement had been tried, but without any great success. One of the chief difficulties encountered is the flaking off or cracking of the material. Metallic substances, especially tin, lead, and tin-lead alloys, have been tried with rather better success, and a special form of ferric oxide has also been recommended and has stood the test of exhaustive trials on a small scale. As far as brass tubes are concerned, the only coating now used on an extensive scale is metallic tin.

Range of Wireless Apparatus.

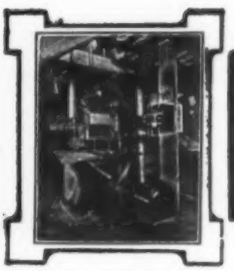
In a recent address by H. R. Sankey, captain in the British army, the following figures were given for the range attainable in wireless telegraphy by apparatus of different powers:

Power Required in Kilowatts.	Range in Nautical Miles — Over Sea.	Over Land — Flat.	Over Land — Hilly.	Over Land — Mountainous.	Wave Length in Meters.
0.3	100	77	30	13	300
0.3	100	95	73	52	1200
1.5	220	170	67	28	300
1.5	220	210	160	115	1200
3	280	220	84	36	300
3	280	270	200	145	1200
5	340	260	100	43	300
5	340	325	240	175	1200
10	470	360	138	59	300
10	470	450	330	240	1200

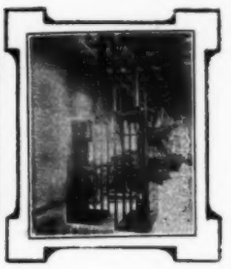
Marconi Stations from Maine to Florida.

A chain of wireless telegraph stations extending from Maine to Florida is now included in the Marconi Wireless Telegraph Company's system, according to the annual report of the company for the past year. New stations were erected during the year south of New York and many coastwise vessels equipped.

According to an item which appeared in the *London Globe* the Maoris of New Zealand are making good progress in the way of rural telephony. A meeting was held by the natives interested in the work and $1,500 raised.



Industrial Power



ELECTRIC DOCK PUMPING.

INSTALLATION AT SASEBO DOCKYARD, JAPAN.

The great advance made in recent years in the application of electrical power in factories and dockyards now allows the heaviest work to be carried out by electrical power. In many cases a considerable saving in capital can be effected thereby. Dry-dock pumping affords an excellent example of the application of electrical machinery in a dockyard where abundant electrical power is available. It is obvious that a large and costly steam plant, with all its attendant expenses of upkeep, etc., and which is only called upon to operate at very irregular intervals, affords anything but an economical solution of the problem. The instance of a powerful plant constructed and equipped by Messrs. W. H. Allen Son & Company, for Sasebo Dockyards, Japan, described in *Engineering*, is a good example of this particular development.

Sectional and plan views of this installation are shown herewith. The pump-house, which covers an area of sixty-four feet by forty-one feet, has its machinery-floor level twenty-nine feet below the high-water ordinary spring-tide level, and contains the complete equipment of three electrically driven main pumps for pumping out the dock and two drainage pumps, as well as the various starting resistances, air-exhausting apparatus for priming the pumps, and hydraulic pump and motor for operating the heavy sluice-valves and penstocks, as shown in Figs. 1 and 2.

The total discharge capacity, which is equally divided between the three main pumps, is 24,000 tons of water per hour, against an average head of twenty-two feet, the pumps in this case being Allen's twin-parallel centrifugal type, a design which enables the dimensions of the machinery to be kept within reasonable limits, and is better adapted to the somewhat higher speeds of electrical driving, where large quantities of water have to be dealt with at moderate lifts. The suction and discharge branches of each of these pumps are forty-two inches in diameter, the discharge pipe being connected by a breeches piece to the two separate discharge outlets of the pump-casing.

The pump casings are of cast iron throughout, divided on a horizontal plane through the shaft axis, the top half being easily removable for examination or repair. The impellers are likewise of cast iron, and securely keyed to mild-steel spindles, which are provided with a half-coupling for bolting to the end of the motor shaft, and carried in white-metal bearings of ample surface. Small connections are made from the discharge volute of the casing to the various main glands, to prevent the entry of air to the pump, with a consequently poor efficiency. Glass water-gauges are also fitted to show when the pump-casings are fully primed, prior to starting up. The weight of the whole of the pump is borne on massive feet, cast in one piece with the lower half and bearing on a massive concrete foundation.

The electrical motors for these main pumps are direct coupled to the pump spindles. They are designed to develop 400 brake horsepower when running at about 352 to 392 revolutions per minute. They are also capable of developing an overload of twenty per cent for one hour, and 100 per cent momentarily.

Close to the far side of the breeches piece from the pump is arranged the forty-two-inch sluice-valve by which the discharge outlet from the pump can be completely closed. The sluices

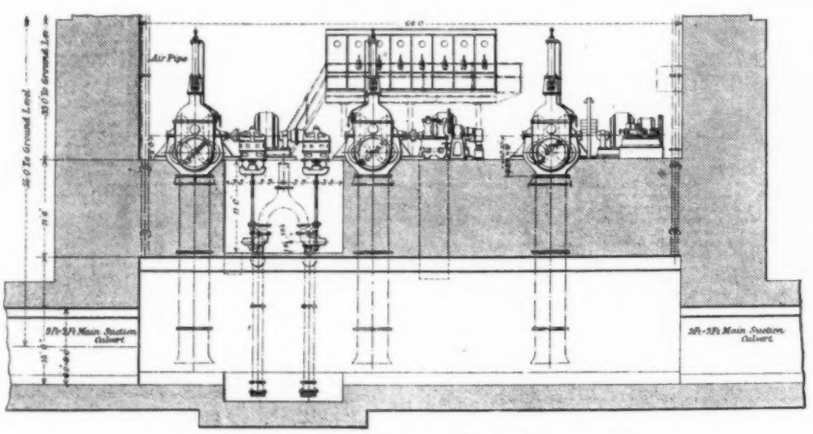


FIG. 1.—SIDE ELEVATION OF DOCK INSTALLATION.

are arranged to lift vertically, and are operated by hydraulic power at a pressure of 750 pounds per square inch, the control valves for the hydraulic cylinders being placed at a convenient level on the side of the valve body. An indicator is provided so that the operator can see at every instant the exact position of the sluice.

The two drainage pumps, which are situated in a well about eleven feet below the level of the pump-room floor, shown in Fig. 3, are of the vertical-spindle centrifugal type, the casings and impellers being of cast iron, as above, and the spindle of mild steel. These have suction and discharge branches of twelve-inch diameter, and draw from a sump in the bottom of the main suction culvert, the lower

end of the suction pipes being fitted with non-return valves and strainers. These pumps are each capable of delivering 2,500 gallons of water per minute against a head of sixty feet when running at a speed of 880 revolutions per minute, and are driven by vertical spindle motors of 120 brake horsepower each, the motors being situated on the pump-room floor level, and direct coupled to the pump spindles by vertical shafting.

To exhaust the air from the several pump-casings a two-throw air pump is provided, having barrels ten inches in diameter and a stroke of seven inches. This is driven through gearing from a six-brake-horsepower motor running at 1,150 revolutions per minute, the air pump making 230 revolutions per minute.

The hydraulic pump is of the three-throw, horizontal, single-acting type,

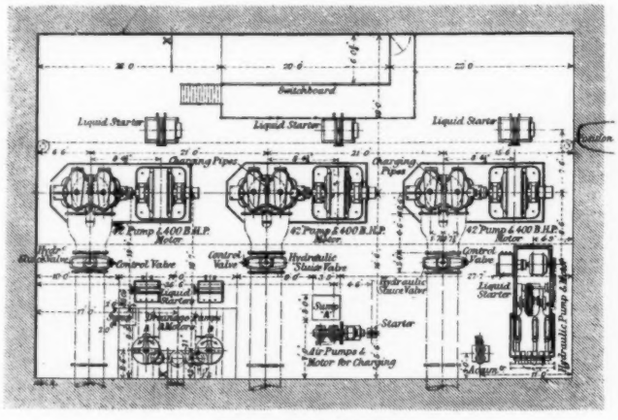


FIG. 2.—PLAN VIEW.

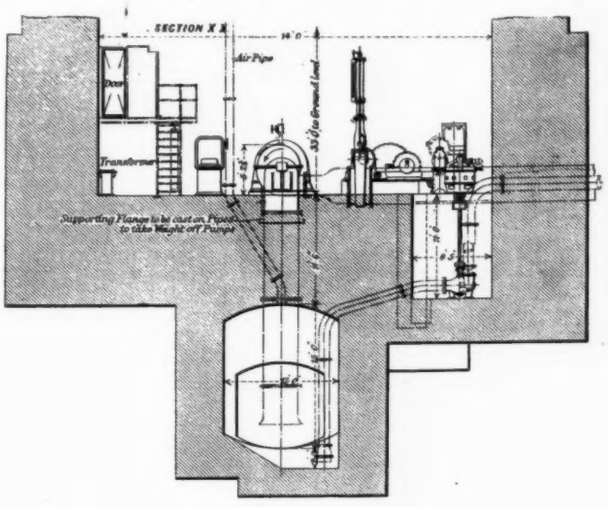


FIG. 3.—END ELEVATION.

with barrels 3.25 inches in diameter by twelve-inch stroke, driven through a double-reduction gear by a fifty-brake-horsepower motor running at 705 revolutions per minute, the motor pinion being of raw hide. The capacity of this pump is fifty gallons of water per minute at 750 pounds pressure per square inch when making forty-six revolutions per minute.

Liquid starters are provided for each of the three main pumps, the drainage pumps, and the hydraulic pump motors; the whole plant being controlled from a switchboard having a raised platform in front, which commands a good view of the whole plant.

Electric smelting of iron ore is being extensively adopted in Norway. Plants at Arendal, Notodden, Trondhjem and Hardanger are applying the new process.

Electrification of London, Brighton & South Coast Railway.

The success attending the electrification of a portion of its suburban lines has resulted in a decision of the London, Brighton & South Coast Railway Company to electrify the whole system of 479 miles, one of the largest in England. It is expected that the electric service will be in operation throughout the system by 1916. The cost of the project for the main line to Brighton alone, 45 miles, is estimated at not less than $7,500,000, and it is said, will make Brighton virtually a suburb of London. About two years will be necessary for the preliminary surveys, and the actual completion of the work will require three more. When completed it will probably offer a service of forty or forty-five minutes between London and Brighton. Single-phase operation will be used.

The portion of the line between London and Victoria has been in operation for over a year, and fifteen miles additional are now undergoing electrification. An account of this work was given recently in a paper before the (British) Institution of Civil Engineers by Philip Dawson, consulting electrical engineer for the railroad, from which the following facts are taken.

The single-phase alternating-current, with overhead conductors at a pressure of 6,700 volts and a frequency of 25 cycles per second, was adopted. The first electric train ran on January 17, 1909, and the full public service was inaugurated on December 1, 1909. The selection of the single-phase system was at the time very severely criticised by many engineers, and foredoomed to failure; but thirteen months' regular working has entirely justified its adoption. The distance between London Bridge and Victoria is 8.7 miles, and the trains accomplish the distance, including ten intermediate stops of twenty seconds each, in twenty-four minutes. The results obtained on the South London line were so satisfactory that the Brighton Company decided to extend the system from Battersea to Selhurst, and from Peckham Rye to the Crystal Palace, thus bringing the total length of route electrified to 23 miles, which is equivalent to 62 miles of single track.

The maximum drop in the earth-return is limited by the Board of Trade to 20 volts. The system of distribution and feeding was specially designed to meet these requirements, and series booster-transformers were used, which have given excellent results, the return drop being well within the required limits. The current for operating the trains is furnished to the Brighton Railway Company by the London Electric Supply Corporation from its power station at Deptford.

The rolling stock of the South London line comprises sixteen motor-coaches, each equipped with four 115-horsepower Winter-Eichburg compensated repulsion motors, and thirty-two trailer-cars, the trains being made up in units of two, three, or four coaches, as required. The rolling stock for the extension now nearing completion comprises thirty motor-coaches, each equipped with four 150-horsepower Winter-Eichburg motors, and sixty trailer-coaches, the train units being composed of two, three, four, six, or

nine coaches. No trouble has been experienced with the overhead conductors owing to the flexibility of the design employed, and the extensions are being constructed to exactly the same design as those originally gotten out for the South London line. The diameter of the trolley wire is one-half inch and it is supported by two catenary wires by means of specially designed insulators of a type not hitherto used for railway work.

The normal working height of the conductor is sixteen feet and the lowest position under certain low bridges is thirteen feet nine inches. Double insulation is used throughout, and the only type of insulation employed is porcelain. The underframes of the coaches consist of plate girders, and the carriages themselves are of a new type as regards this country, being fitted with side doors and having a passage-way between compartments.

The motors have four poles and are fitted with six sets of brushes. The air gap of the motors is three millimeters and the synchronous speed is 750 revolutions per minute, although the motor is capable of developing torque at speeds higher than this. The gear ratio adopted, after the most careful calculations, as the most suitable for the service, is 4.24 to 1. The actual current taken per motor at starting on the low-tension side is 210 amperes, with a power-factor of 29 per cent. Each motor-car is fitted with two main transformers, rated at 220 kilowatts each, one for each pair of motors. None of the high-tension circuits on the car are accessible except when the collector-bows are lowered and when all the high-tension gear is earthed; the collector-bows are kept against the trolley wire with springs which are brought into operation by means of a piston worked by compressed air. The contact surface is aluminum and easily renewable, one contact-strip running 5,000 to 6,000 miles and taking practically all the wear; after thirteen months' running no appreciable wear can be measured on the trolley wire. The pressure of the bow-strip against the trolley wire varies between eight and twelve pounds. The control of all the motors on the train is effected by means of contactors placed on each motor car and worked by a master-controller in every motorman's compartment, on the multiple-unit control system, in every way similar to that in use with direct-current motors.

The overhead conductor has interfered very little with the signaling system.

The motors were tested very carefully by the author at the maker's works, and, in addition to the ordinary measurements, a test was made on a complete equipment rigged up as for service conditions, with an artificial load on the motor. As much as 180 horsepower was repeatedly thrown suddenly on and off without any tendency to flash over. The largest starting torque measured was 1,847 pound-feet. A series of tests were made to show the heating of the motors under varying loads, with the following results, the motors being run with open covers, the temperature rise not exceeding 75 degrees centigrade.

Load. Horsepower.	Time for Temperature to rise 75 degrees Centigrade. (Minutes.)
187	17
149	37
129	46
117.5	64
91	110
63.5	110
57	Continuous.

For the trial runs a three-car train, consisting of two motors and one trailer, was used, being loaded up to a total weight of 146 tons. It was run continuously for twelve hours with twenty-second stops at each station, and covered in this time a distance of 173.58 miles, the average length of run being 0.79 miles. At the conclusion of this run the maximum rise of temperature of any part of the electrical equipment was 66 degrees centigrade. During this test the following results were obtained: power-factor, 80.8 per cent; maximum current at starting, 126 amperes; energy consumption, 73 watt-hours per ton-mile. After the train had run for some time, further tests were taken, which showed a considerable improvement as regards energy consumption, 65.7 watt-hours per ton-mile for a schedule speed of 22 miles per hour, including twenty-second stops at each station, being obtained. The influence of a long run on the energy consumption is shown by the fact that for a through non-stop trip from Victoria to London Bridge at an average speed of thirty-seven miles per hour the energy consumption was 34.4 watt-hours per ton-mile, the maximum speed reached during the run being fifty miles per hour.

Tests made to ascertain the efficiency between the high-tension bus-bars of the power station and the trains showed that this was equal to 96.6 per cent. Calculations made from the results obtained during the running show that the efficiency of the system during controller notching is very high, the figure for this being 67 per cent.

The service on this railway is an exceptionally heavy one, as shown by the fact that for the first year's running the mileage per motor-coach owned, including all spares, as well as those undergoing the annual overhaul, averaged 58,000 miles per annum. As regards the maintenance of the electrical apparatus, the first thirteen months' experience shows no reason why the maintenance of single-phase should be higher than that for direct-current apparatus. The system is certainly more economical than the direct-current system as regards energy consumption at the power station as well as regards first cost. Experience has shown it to be eminently suitable, not only for long-distance work, but particularly for working in and out of large terminal stations, with their necessarily complicated approaches, and for short-distance work, such as has had to be encountered on the South London line.

Single-Phase Railway in Lorraine.

The electric railway which joins the small town of St. Avold, in German Lorraine, to its railway station, has only a length of 1.5 miles but is interesting as an example of a monophase railway operated at fifty cycles. The track is almost throughout on a gradient of 50 in 1,000 (74 in 1,000 maximum), and there is not much traffic. Current is obtained at 1.6 cents per kilowatt-hour at a colliery six miles distant. The overhead line is fed from two transformers with current at 750 volts. There are two motor-carriages and trailers. The carriage is fitted with two sixty-horsepower motors (6 poles) for 700 revolutions, each weighing about 2.5 tons, together with its toothed gearing. Current is taken up with a double-contact rod.

Proposed Industrial Power Plant.

The W. H. McElwain Company, which operates a number of factories in Manchester, N. H., will, in the near future, construct an electric generating station of sufficient capacity to operate all of the company's shops. The cost is estimated at $250,000.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ELECTRIC STORAGE BATTERY COMPANY.

The Electric Storage Battery Company has issued its annual report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
†Gross sales	$1,314,223	$1,218,483
Operating expenses	442,650	384,021
Net	871,572	834,461
Other income	248,440	99,030
Total income*	1,120,012	933,492
Dividends	649,964	528,092
Surplus	470,048	405,398
Previous surplus	2,358,816	2,003,678
Total surplus	2,828,864	2,409,076
Adjustment, debit	56,923	50,260
Profit and loss surplus	2,771,942	2,358,816

†Less cost of manufacture and purchase and expenses incident thereto.

*Equal to 6.22 per cent on $18,000,000 capital stock ($185,400 preferred) as compared with 5.18 per cent earned on same stock in previous year.

‡Includes $1,940,000 depreciation Electric, Vehicle Securities, less $223,450 increment from appraisement of factory above book valuation, etc.

AMERICAN LIGHT & TRACTION.

The report of the American Light & Traction Company for the month of February and two months ended February 28 compares as follows:

	1911.	1910.
February gross	$ 358,908	$ 311,549
Expenses	8,942	9,285
February net	349,966	302,264
Two months' gross	760,233	690,824
Expenses	18,684	17,786
Two months' net	741,549	673,038

WESTERN ELECTRIC COMPANY.

The Western Electric Company has issued its report for the thirteen months ended December 31, 1910, on account of changing its fiscal year, which formerly ended on November 30. The income account compares with the twelve months ended November 30, 1909, as follows:

	†1910.	1909.
Gross sales	$68,375,150	$45,575,000
Other income	486,305	.....
Total income	68,861,455	45,575,000
Manufacturing costs, expenses, etc.	63,442,286	43,206,000
Net earnings	5,419,169	2,369,000
Interest charges	884,893	280,000
Balance for dividends	*4,534,276	2,089,000
Dividends	1,700,000	1,200,000
Carried to reserves	1,150,000	.....
Surplus	1,684,276	889,000

* Equal to 30.2 per cent on $15,000,000 capital stock as compared with 13.9 per cent earned on same stock previous year.

† Thirteen months ended December 31.

President Thayer says in part:

"The fiscal year which has heretofore ended November 30 has been changed to December 31 to meet the requirements of the Federal corporation tax law. Results shown in the report are, therefore, for thirteen months, as compared with twelve months for 1909.

"There have been no increases in prices during the year, as might have been justified by increased cost of labor and material.

"For the thirteen months, orders received in America were 896,000, compared with 695,000 in 1909, an increase of nineteen per cent and the value of an order for 1910 was $72 compared with $62 for 1909.

"Additional buildings authorized during 1909-10 and now in use aggregate 235,000 square feet for floor space. Manufacturing plants have been worked to full capacity during the year. For 1911 additions at Hawthorne have been authorized amounting to $1,000,000.

"During the year the company sold its Clinton street and Polk street properties in Chicago for $3,247,204. These properties were carried on the books at $2,759,971. The profit of $487,252 has been carried to reserves.

"On January 1, 1911, the number of employes was 23,464 compared with 17,835 December 1, 1909.

"Total current assets, including sundry investments less all liabilities except first mortgage bonds, on January 1, 1911, were $42,695,123."

CHICAGO CITY RAILWAY COMPANY.

The Chicago City Railway Company has issued its pamphlet report for the year ended January 31, 1911. The income account compares with the twelve months ended January 31, 1910, the thirteen months ended January 31, 1909, as follows:

	Twelve Months Ending— Jan. 31, 1911.	Jan. 31, 1910.	Jan. 31, 1909.
Pass. rev.	$ 9,762,275	$8,735,705	$8,979,735
Other rev.	343,169	358,343	216,047
Total rev.	10,105,444	9,094,047	9,195,782
*Expenses	8,596,509	8,230,734	8,169,494
Net op. rev.	1,508,935	863,313	1,026,288
City 55%	829,914	474,823	564,458
Co. 45%	679,021	388,490	461,830
Int. on capi.	1,994,939	1,864,901	1,732,446
Inc. from op.	2,673,960	2,253,392	2,194,276
Total inc.	3,113,140	2,809,107	2,849,482
Other inc.	439,180	555,714	655,206
Int. on bds.	1,127,708	1,110,666	849,739
Net inc.	1,895,432	1,698,440	1,999,743
Dividends	1,800,000	1,080,000	1,620,000
Surplus	185,432	618,440	379,743
% of net to stock	11.03	9.44	11.11

*Operating expenses, taxes and renewals of combined systems, interest on capital investments of Chicago City Railway, and net earnings of Southern Street Railway.

President T. E. Mitten says: The completion of work required during the rehabilitation period ended April 15, 1910, has been accomplished.

Adequate provision being contained in the settlement ordinance, under which we are now operating, insuring the establishment of reserves sufficient to effectually maintain the present physical excellence of the property, there remained, in the opinion of your directors, no reason for longer conserving the large treasury surplus, which as of January 31, 1910, exceeded the par value of the capital stock to the amount of $1,319,891. Distribution of a portion of this surplus has therefore been made during the year by the payment of extra dividends, aggregating six per cent upon the capital stock.

The following changes in the official personnel of Chicago City Railway have been made: Ira N. Cobe succeeds Mr. Spoor as chairman; Vice-President Hamilton, General Counsel Dusby and Harrison B. Riley succeed Edward Morris, E. A. Valentine and Honore Palmer, resigned. President Mitten was re-elected.

HUDSON & MANHATTAN.

The Hudson & Manhattan Railroad Company report for the month of February compares as follows:

	1911.	1910.
Gross revenue, all sources	$ 362,271	$ 309,276
Expenses and taxes	164,348	129,101
Gross income	197,923	180,175
Interest on bonds outstanding	226,436	243,165
Less interest chargeable to construction	50,469	72,227
Balance	175,967	170,938
Other charges	22,107	17,630
*Total deductions	198,074	188,568
Deficit	152	8,393

*Being fixed charges applicable against that portion of the property employed in present operations.

From July 1 to February 28, gross revenue amounted to $2,785,035; gross income, after expenses and taxes, $1,508,682, and deficit after charges, $53,329.

KANSAS CITY RAILWAY & LIGHT

The report of the Kansas City Railway & Light Company for the month of February and nine months ended February 28 compares as follows:

	1911.	1910.
February gross	$ 599,951	$ 553,543
Expenses	321,764	286,727
February net	278,187	266,815
Charges and tax	190,263	164,810
February surplus	87,924	102,005
Nine months gross	5,770,148	5,339,159
Expenses	3,378,428	3,007,383
Nine months net	2,391,719	2,231,775
Charges and taxes	1,701,578	1,543,564

CITIES SERVICE COMPANY

The Cities Service Company report for the five months ended February 28, compares as follows:

Earnings on stocks of subsidiary companies owned, etc.	$427,803
Expenses	10,011
Net earnings	417,819
Preferred dividend	198,890
Balance	218,929
Common dividend	57,916
Surplus	161,013

UNION ELECTRIC LIGHT & POWER

The report of the Union Electric Light & Power Company, of St. Louis, Mo., for the year ended December 31, 1910, compares as follows:

	1910.	1909.
Gross revenue	$3,371,520	$3,085,614
Operating expenses, taxes and reserve	1,767,211	1,503,034
Net revenues	1,604,309	1,582,580
Interest charges	823,341	834,204
Surplus	*780,967	748,376

*Equal to 7.9 per cent on $9,885,000 capital stock as compared with 7.58 per cent earned on same stock previous year.

New Electrical and Mechanical Apparatus and Appliances.

An Important Improvement to the Moore System of Lighting.

Among the various systems of illumination which have been brought to the attention of engineers and which have been persistently developed for the last few years, the Moore vacuum-tube system of electric illumination holds a rather unique place. Ordinarily the Moore system of lighting has been referred to as that system which has employed units of larger dimensions than any other system of electric lighting. In fact, some of the Moore light tubes in commercial operation are 240 feet in length and the installation of tubes of these dimensions necessarily means special construction upon the premises, special auxiliary apparatus, and workmen familiar with the system. As the methods of installing this system have become simplified the field of operation has been enlarged. However, until the most recent improvement, which is now announced, it has been impracticable to build the Moore system of illumination as a self-contained apparatus for shipment to any destination. One of the features of the Moore system requires a valve for feeding various gases automatically to the gas column of the tube, and this valve was of such a nature that in the event of the valve being turned upside down it would permit air or other gases to leak into the tube in such quantities as to vitiate the vacuum of the tube. When this happened the lamp could not be operated until the vacuum had again been raised by means of a vacuum pump to the point where the necessary low pressure for permitting the electric discharge to easily pass through was secured.

FIG. 1.—TYPE "D-8" MOORE LIGHT.

A recent improvement in the Moore light is the type "D-8" apparatus shown in Fig. 1, which has been designed for localizing the distribution of light. One of the principal claims of the Moore light is its unique value for color matching and in order to substantially duplicate the natural window lighting this Moore window light was developed. The upper portion of the apparatus is about the size of an ordinary dress-suitcase and contains a Moore light tube within a rectangular sheet metal case. This case, as is shown in the diagram, is easily detachable from the transformer upon which it rests.

Fig. 2 shows the same apparatus with the back cover removed and also illustrates the method of connecting the two parts together. In Fig. 2 at the center there will be noticed the gas-feeding valve. The cylinder to the right of the feed valve is the CO_2 gas generator, which is also automatic as it generates an extremely small quantity of gas only at the moment when it is required. On each side may be seen the electrodes of the light tube which is in front of its reflector. The simple electric circuits and connections show

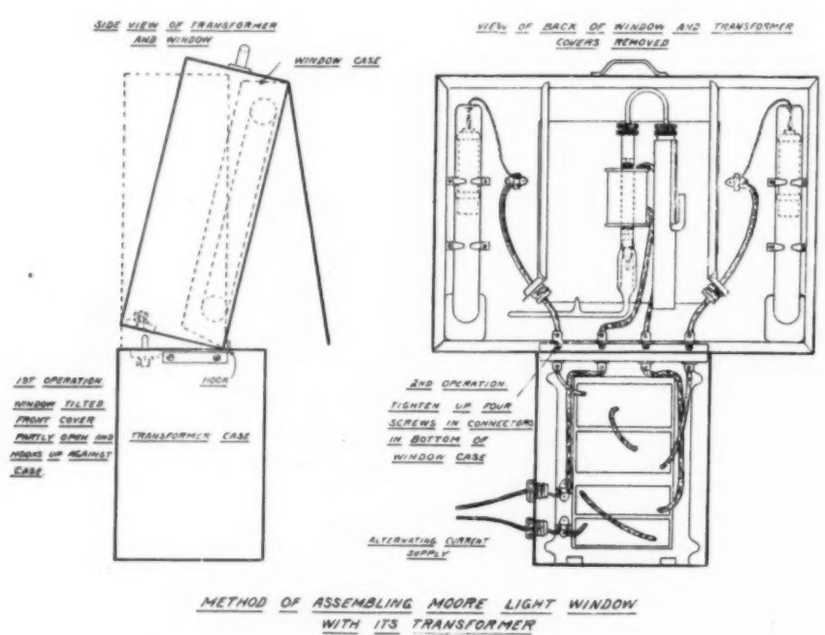

SIDE VIEW OF TRANSFORMER AND WINDOW
WINDOW CASE
1ST OPERATION
WINDOW TILTED FRONT COVER PARTLY OPEN AND HOOKS UP AGAINST CASE
HOOK
TRANSFORMER CASE
VIEW OF BACK OF WINDOW AND TRANSFORMER COVERS REMOVED
2ND OPERATION
TIGHTEN UP FOUR SCREWS IN CONNECTORS IN BOTTOM OF WINDOW CASE
ALTERNATING CURRENT SUPPLY
METHOD OF ASSEMBLING MOORE LIGHT WINDOW WITH ITS TRANSFORMER

FIG. 2.—DIAGRAMMATIC VIEW OF NEW MOORE LIGHT.

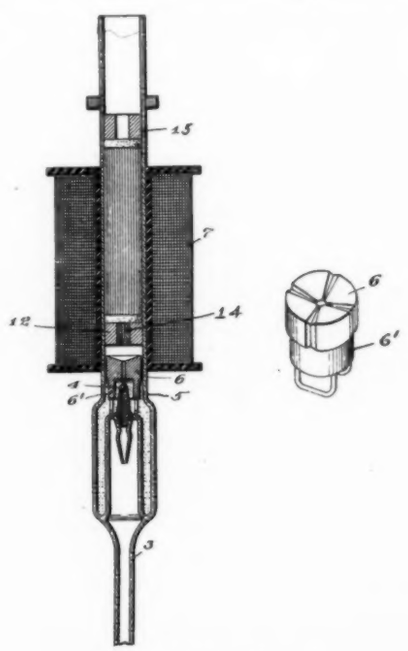


FIG. 3.—FEED VALVE.

that the feed magnet coil is connected in series with the service side of the transformer.

Fig. 3 illustrates the ordinary form of feed valve. A solenoid acts on a small iron core within the glass tube. When this core is raised magnetically from the pool of mercury in which it rests, the tip end of a small carbon plug is exposed above the surface of the mercury so that the carbon-dioxide gas which the light tube requires can permeate downward through the pores of the carbon plug. The plug, however, is not porous enough to allow the mercury to pass. Thus the gas finds its way into the lighting tube. Immediately after a very small quantity of the gas has passed through the plug the resistance of the gas column changes and the pull on the solenoid changing proportionately allows the iron core to sink into the mercury pool, raising the level of the mercury above the carbon pit, and insulating the carbon plug against any further passage of gas. The valve shown in Fig. 3 is so designed that it makes no difference what the position of this feed valve may be, as until acted upon magnetically the carbon feed-plug is always completely immersed. When this is in its normal vertical position and its plunger is magnetically raised, the automatic gas-feeding functions are perfect. Above the iron core is a rubber stopper, at the center of which is placed a porous plug. This rubber stopper is far enough above the iron plunger to permit of a normal feeding movement. The diameter of the mercury chamber has been enlarged over that of the iron core diameter, so that when inverted there is sufficient mercury available to fill the space above the core or plunger, and continuously submerge the carbon feed plug. Above the rubber stopper is placed the iron wire core which is held immovable by another rubber stopper above it. This stopper has a hollow center so that once the gas has entered the top of the main gas valve tube it easily finds its way to the lighting tube.

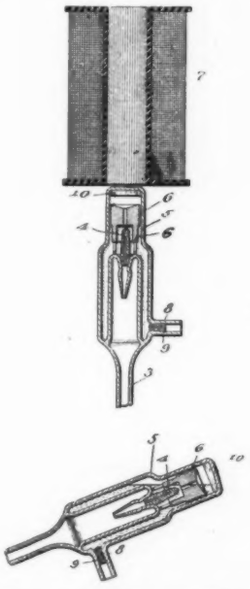


FIG. 4.—MODIFIED FORM OF FEED VALVE.

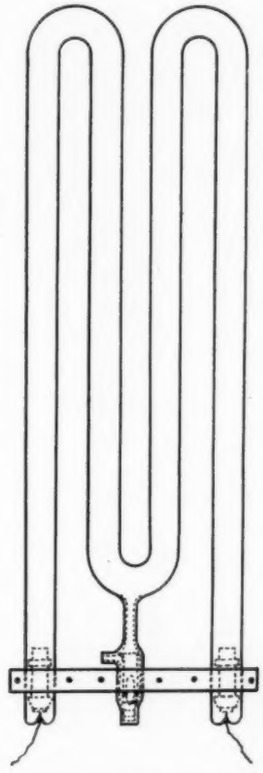


FIG. 5.—TYPICAL TUBE ARRANGEMENT.

Fig. 4 shows a modification of this valve which makes unnecessary the threading of the glass tube through the solenoid. This improvement makes available an absolutely independent Moore light vacuum tube. This form of feed-valve is entirely separable from the magnetic apparatus. An example of a tube arranged in this fashion is shown in Fig. 5. Numerous modifications, however, of this important principal are available so that complete shippable vacuum tubes immediately suggest themselves and the field of usefulness of the Moore light is thus greatly increased.

The apparatus as shown in Fig. 1 is suitable for installations in die shops, mills, etc., but to supply the demand of the retail business, particularly for a light suitable for color matching, the apparatus illustrated in Fig. 6 has been developed. Here another change has been made in designing the apparatus to hang pendant from the coiling in a manner similar in all respects to the way in which arc lamps are usually supported. This form of apparatus is applicable to a large number of industries, notably to the dry-goods trade.

New Chicago Store of Metropolitan Electrical Supply Company.

The Metropolitan Electrical Supply Company, of 180 West Lake street, Chicago, has opened a new branch store at 62 East Jackson Boulevard, in the Wellington Hotel Building. This store was opened in response to the demand for a retail store handling electrical goods on the east side of the "loop district," practically all other stores being segregated in a district on the west side.

FIG. 6.—ASSEMBLED FIXTURE.

"Everything electrical" is the slogan of this company, and accordingly the new store is stocked to supply all needs in the electrical industry.

The Jackson Boulevard branch is in charge of William Parritt, Jr., who was associated with E. Baggott Company for twenty-four years.

Switchboard Wattmeters.

A new form of electrodynamometer wattmeter has recently been brought out by the Weston Electrical Instrument Company, which announces that the instruments of this new type embody the results of exhaustive investigations which have extended throughout a period of many years. Indeed, the construction bears much evidence of this original work and every detail appears to have been given the most careful study.

It is impossible in the space here available to give more than the briefest description of the construction, touching upon a few of the many novel constructive features and some of the unique operative characteristics.

These wattmeters are made in two models and forty-one ranges. One model is intended for single-phase and

FIG. 1.—SINGLE-PHASE WATTMETER.

direct-current work, and the other is for polyphase work. The single-phase wattmeter is mounted either in full-front or full-flush-type cases, while the polyphase wattmeter in addition to these two styles is also mounted in a semi-flush type case which is so proportioned as to bring the face of the instrument in the same plane with the fronts of other Weston switchboard instruments in the new alternating-current group.

The general construction and arrangement of the parts may be seen in Figs. 3 and 4, which show the working parts of a single-phase and a three-phase wattmeter respectively. The entire working system is self-contained, being mounted on a single base which is secured to the back of the case. By removing two stud bolts the complete movement can be taken out without removing the instrument from the board or disturbing the switchboard connections. The construction is extremely neat, simple and accessible.

Supports made of a special high-strength, high-resistivity alloy carry the field coils and the upper jewel.

FIG. 2.—SEMI-FLUSH POLYPHASE WATTMETER.

These supports are so designed as to reduce eddy currents to a negligible quantity. Tests at frequencies as high as 900 cycles per second failed to show errors greater than one per cent even at low power-factors.

The field coils are maintained in coaxial position by internal flanges, and in accurate alinement by the coil supports themselves, which are rolled to gauge for this purpose.

The movable coil is circular in form. It is wound to gauge with silk-covered special-alloy wire. While winding, the coil is spread at diametral points and afterward fitted with tiny curved plates provided with a hole that exactly fits the staff on which the coil

FIG. 3.—INTERIOR OF SINGLE-PHASE WATTMETER.

is mounted. The completed coil is treated with a special cement which makes it self-supporting and gives it astonishing rigidity. In order to locate the coil in a definite and permanent position with reference to the rest of the system, tiny pins pass through the staff and engage ears on the curved plates mentioned in the preceding paragraph.

By properly choosing the proportions and relative positions of the field coils and the movable coil a uniform-scale characteristic has been attained in every instrument of this complete line. This is quite an achievement, since these are the first switchboard wattmeters of this type to have a proportional scale. A proportional or uniform scale facilitates the reading of the load from a distance, which is of great importance in switchboard work.

One of the most important operative characteristics claimed for these wattmeters is their ability to indicate rapidly fluctuating loads with substantially the same accuracy as they do steady loads. The possession of this characteristic is partly due to the general excellence of design, which gives a high ratio of torque to weight with a very low weight of movable system

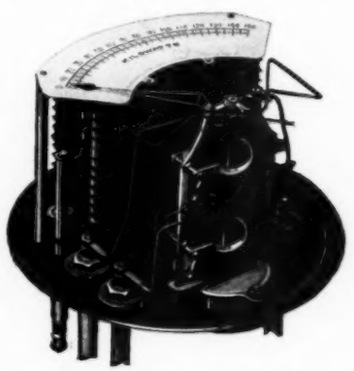


FIG. 4.—INTERIOR OF POLYPHASE WATTMETER.

and a small moment of inertia, and partly to a highly perfected air damper.

The makers claim that in the present construction they have attained a theoretically and practically perfect damper, and, in fact, the results seem to warrant that characterization of this new device. The damping effect is exactly the same at all parts of the scale, namely: just enough overswing to demonstrate the absence of friction.

The damper consists of two symmetrically mounted vanes inclosed in chambers, which are cast in one piece with the base. The vanes are made of an exceedingly light alloy sheet stiffened by ribs stamped into the metal and by turning over the edges. They are mounted as close as possible to the axis and are made to fit accurately the walls of the chambers. These chambers are fan-shaped and have tapered

walls, which facilitate assembly with small clearance. Each chamber (see Figs. 5 and 6), is closed with an air-tight cover, the only opening to the outside being a very small arc-shaped slot which provides clear space for the movement of the arm that carries the vane. The leakage to and from the outside through this space is useless leakage, since it tends to prevent compression and rarefaction of the air and thus to destroy the effectiveness of the damper. By making this useless leakage very small in comparison with the useful leakage directly around the edges of the vane, the damping effect is brought directly under control of the designer, who can get any desired degree of damping simply by suitably dimensioning the clearance space. This construction is a marvel of accuracy and delicacy and yet it is amply strong to stand any kind of service.

Another distinctive feature of these

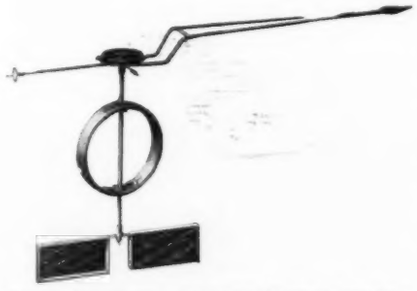


FIG. 5.—MOVABLE SYSTEM, SINGLE-PHASE WATTMETER.

new instruments is the pointer, which has been given the form of a triangular truss. After conducting a long series of experiments the maker states that it was found that this construction was best suited for indicating instruments on alternating-current circuits, as it enables the construction of a pointer which has an extremely high period of vibration and yet keeps the weight and moment of inertia at very low values. The entire movable system shown in Fig. 7 weighs only 1.83 grams. The natural period of the trussed pointer is so high that it will not be set in resonant vibration at any commercial frequency between 15 and 900 cycles per second.

An innovation which should be welcomed by the user is a provision for adjusting the pointer to its zero position from the outside of the case. This is accomplished by a device which engages one of the spring abutments and can be manipulated with a screw driver, from the front without breaking the seals or removing the instrument from the board. By means of this simple device spring sag, caused by shocks during transportation, can be remedied

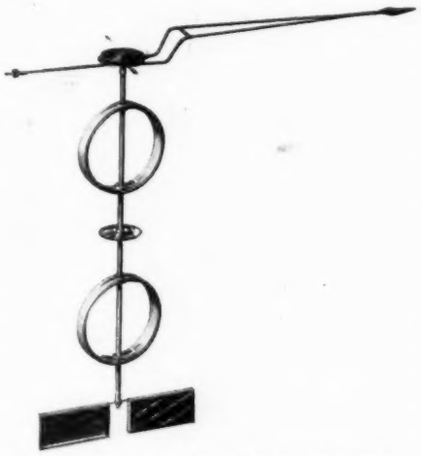


FIG. 6.—MOVABLE SYSTEM, POLYPHASE WATTMETER.

by anyone in a few seconds time. Furthermore, this adjusting mechanism is so constructed that it is impossible to damage the instrument by any accidental or wanton misuse of it.

Another improvement which facilitates the proper installation of the instrument is embodied in the construction of the terminals. In none of the full-front type instruments is it necessaray to drill more holes through the board than there are terminals. Terminals up to twenty amperes current-carrying capacity are surrounded by wrought-iron sleeves which are threaded and provided with nuts for fasten-

FIG. 8.—COIL SUPPORTS, POLYPHASE WATTMETER.

ing the meter to the board. These sleeves also serve to protect the terminals and enable them to pass directly through the structural steel work of the board without danger of grounding. Being conductively connected to the case they also serve as ground terminal. Meters of ranges above twenty amperes have terminals large enough to serve directly as fastening bolts and the sleeves are not necessary in these sizes.

The polyphase wattmeters consist of two specially designed single-phase movements which are mechanically coupled to the same staff and pointer. The construction is clearly shown in Figs. 4, 6 and 8.

The accuracy claimed for these wattmeters is extremely unusual. Their indications are guaranteed to be correct within one per cent, independent of changes in frequency from 15 to 900 cycles per second; from variations in temperature from fifty degrees Fahrenheit to fifty degrees above normal; of power-factor fluctuations between 0.50 lag and 0.50 lead, and of wave-form variations encountered in ordinary

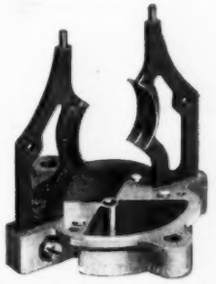


FIG. 7.—COIL SUPPORTS, SINGLE-PHASE WATTMETER.

commercial practice.

These instruments are equally accurate on direct-current circuits and alternating-current circuits without change in calibration or reversal of the leads.

The Ideal Electric Vehicle Company of Chicago.

The name of the company manufacturing the Ideal electric vehicle was recently changed from "Ideal Electric Company" to "The Ideal Electric Vehicle Company," and the capitalization was at the same time increased to $250,000. The company is also moving into a new two-story building at 308 East Huron Street.

Officers of The Ideal Electric Vehicle Company are as follows: president, Bruce Borland; vice-president, Uri B. Grannis; second vice-president, Chauncey B. Borland; treasurer, Cyrus H. Adams, Jr., and secretary, Mark S. Willing.

New Large-Capacity Time Switch.

The large capacity time-switch, just brought out by the Hartford Time Switch Company, of 97 Warren Street, New York, is of more than usual interest in that it is designed to handle current up to 300 amperes by a new mechanism which entirely eliminates the difficulties heretofore encountered.

In the Hartford large-capacity switch, a standard switch of the size approved by the Underwriters for the rated capacity, is used, and this is operated by a simple and rugged mechanism which has the great advantage of making an "instantaneous break" without shock or jar and at the same time being absolutely infallible in its operation. One of the greatest dangers with many forms of apparatus of this type is that if allowed to run down, they would have a tendency to stop with the switch partly opened or partly closed, just sufficient to permit of continuous arcing, resulting in the destruction of the switch and serious fire risk. No automatic time switch, using a reciprocating type of switch, operated directly from a coiled spring, can provide against this contingency if the spring is accidentally allowed to run down. In the Hartford large-capacity switch, this is prevented by an entirely new construction, in which a flat-leaf spring affords the power for the reciprocating action of the knife switch. The spring is never under tension except for a few seconds at the actual time of opening or closing the switch and its operation is so controlled that the switch can never be released from its locked-closed or locked-open position until the spring has exerted the necessary pressure to complete the cycle. A powerful spring motor furnishes the means of operating this leaf spring, and while it is possible for the spring motor to run down, if neglected or forgotten, it is never possible for it to effect the positive action of the knife switch, which will remain in either one of its locked positions until properly released. A high-grade Seth Thomas eight-day clock movement, entirely separate from the spring motor, affords accurate control of the desired periods of opening or closing the switch at predetermined hours, and as the entire mechanism is inclosed in a solid cast-iron case with rubber-gasketted door, making it entirely waterproof, it is claimed by the makers that if the mechanism is oiled once a week, it will operate indefinitely without other attention than that of winding once per week.

The switch is made in the same large range of types as the well known Hartford time switch which has been on the market for many years in smaller capacities and can be had in forms which permit of four operations daily, eliminating the Sunday operation, controlling two-rate meter service, etc., as well as the standard type which gives two operations daily, including Sunday. By a slight modification, this type of large capacity switch is also furnished to operate high-tension currents up to and including 2500 volts, making and breaking the current in an oil chamber, this type taking the place of much more expensive and complicated apparatus designed for the same purpose.

HARTFORD LARGE-CAPACITY TIME SWITCH.

The manufacturer states that this switch is the result of many years continuous experience in making the Hartford time switch. This large-capacity switch was announced several months ago and a few of these switches in daily actual service on tests for over a year, have shown the way to such few refinements as hard usage could suggest. Its simple and positive mechanism, free from delicate adjustments, its rugged construction, combined with a quality of workmanship, and its absolute certainty of operation, certainly leave nothing to be desired.

Electric Smelting of Copper Ore.

A new method of electric smelting is being applied to copper ores in Norway, and the first consignment of twenty-five tons of the metal has been exported.

A New Molded Insulator.

So many new insulating materials have been recently introduced claiming heat-resisting qualities that to the uninitiated there would seem to be little room for improvement along these lines. To users, however, it is well known that while there are a number of excellent heat-proof materials on the market there are few which have been sufficiently developed beyond the experimental stage to insure uniform and continuous production.

It is, therefore, of interest to learn that Emile Hemming, chemist of the Hemming Manufacturing Company, and the inventor of its well-known "Gummon" and "Hemit" molded insulating materials, has, after a long series of experiments and careful tests, succeeded in producing a new material which, it is claimed, possesses great dielectric and tensile strength and all of the elasticity and resiliency of the older forms of shellac compounds, which it is designed to replace owing to its heat-resisting qualities. "Tegit," as this new material has been named, its makers claim, is not affected by temperatures up to 600 degrees Fahrenheit, and is absolutely waterproof, not warping or cracking when subjected to climatic changes.

It is further claimed for "Tegit" that it has been successfully produced for some time and is being placed on the market only after the manufacturing process has been perfected to a point insuring a standard reliable product.

While "Tegit" is designed to meet conditions for which "Gummon" or "Hemit" may not be entirely suited, it will not replace these materials for the many purposes for which their pre-eminent characteristics make them desirable.

The Hemming Manufacturing Company, of Garfield, New Jersey, are the manufacturers of this new product.

Storage Battery in Car Test in Philadelphia.

A test of a street car equipped with Edison nickel-iron storage battery was made in Philadelphia a short time ago and was successful from every point of view. The new vehicle loaded with iron corresponding to the weight of thirty-five passengers made a round trip, with stops, starts and reverses on one of the city's longest street-car routes.

New Wesco Fan.

The "Wesco" 1911 model eight-inch fan for alternating current is an entirely new model of exceptionally attractive appearance and operating qualities.

This new fan is an induction type without brushes or commutator. The only wearing parts of this motor are the bearings, which are provided with self-feeding wick oil cups.

This new fan is light and readily portable, weighing but seven pounds net and about twelve pounds packed for shipment. However, strength has not been sacrificed to diminish the weight of the motor. The shaft, bearings and all parts subject to wear or strain have been carefully designed to meet all requirements of severe service conditions. Great care and accuracy of manufacture make this motor a most efficient and satisfactory one.

The motor frame and base are of drawn brass, and the fan blades, body and base are furnished in highly ornamental brushed brass, satin finish. The trimmings of the motor are black, combining in a very pleasing manner with the satin-finish brass of the body and base. The guard is of the double-ring type, fully protecting the ends of the blades. It is made entirely of brass without soldered joints, and is dipped and lacquered. A four-point switch giving three running speeds is concealed in the base of the fan, operated by a lever projecting conveniently, with definite stops at the "On" and "Off" positions, so that there is no danger of leaving current on the fan unintentionally. Exceptionally good speed regulation is a feature of this new motor, the speeds being approximately 1,600, 1,400 and 1,250 revolutions per minute, respectively.

WESCO 1911 FAN.

The base is of the hinge type, permitting adjustment as a desk or bracket fan and giving the trunnion effect by permitting the blades to be tilted upward or depressed as desired.

While throwing a strong breeze, this new "Wesco" fan requires but twenty-five watts on the fast speed, twenty watts on the medium speed and fifteen watts on the slow speed.

"Wesco" eight-inch induction fans are made for sixty cycles, any voltage 100 to 125 volts, but are not made for other frequencies or voltages higher than 125 volts.

Trolley-Wire Splicer.

A trolley-wire splicer that can be used without bending tools or wrenches is illustrated in Fig. 1. It is manufactured by the Westinghouse Electric & Manufacturing Company and known as the Cleveland type.

FIG. 1.—TROLLEY-WIRE SPLICER.

The distinctive feature of the splicer is the method of securing the wire. A tapered and slotted chuck, as shown in Fig. 2, fits snugly around the wire. The chuck is threaded on the inside, and when inserted in the tapered hole in the splicer, firmly grips the wire. The greater tension there is on the wire the firmer the grip becomes, and it is impossible to pull the wire out of the splicer. The chuck is easily removed when it is desired to take up slack.

The body of the splicer is twenty inches long and the metal is so distributed that there is no danger of failure. The boss shown in the illustration is detachable so that it can be removed if suspension is not required. The approaches are so proportioned that smooth under-running is obtained.

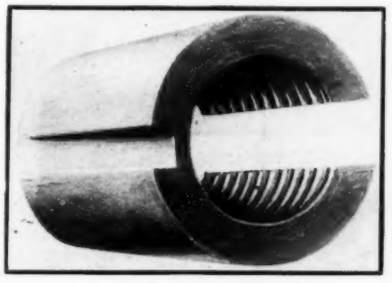


FIG. 2.—TAPERED SLEEVE.

Large Power Plant Proposed.

As part of its great electrification project for eastern Pennsylvania, the Lehigh Coal & Navigation Company will build a $10,000,000 power plant, one of the largest in the country. It is proposed to make electricity at the mouth of the mines and transmit it over high-tension lines to cities and towns many miles distant.

Improved Type of Shunted Direct-Current Watt-Hour Meter.

The increasing importance of economy in switchboard space, especially in the larger stations, has created a demand for large capacity meters which can be installed in close proximity to each other. The shunted type of meter is especially suitable for this class of service in that the meter itself can be made of smaller dimensions than is possible with the series type of meter, in which all the current to be measured has to be passed through the meter itself. With the shunted principle the main series shunt can be located at any desired point.

The Sangamo Electric Company has long employed the shunted principle in its direct-current meters and has further improved their construction by the addition of a large circular dial having a fast-moving pointer in addition to the regular four-dial register.

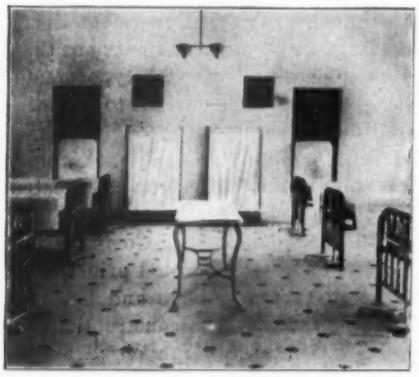
The Sangamo meter is known as the "mercury-motor type" because in it mercury is employed to form the electrical contact in place of brushes as used on the commutator type of meter. The shunted principle of operation is especially valuable in meters intended for use on high-capacity direct-current switchboards where it is desirable to employ watt-hour meters, graphic recorders and indicating ammeters. These three meters can be operated from a single Sangamo shunt, thus effecting a saving which in many cases, such as on a 10,000-ampere circuit, will amount to several hundred dollars on a single installation. In addition to the economy secured by this method of metering, it is also very desirable in that the meters can be quickly and easily checked without interrupting the main circuit.

SANGAMO SHUNTED WATT-HOUR METER.

Chicago is said to have more private residences wired for the use of electric-light service, and its attendant conveniences and appliances than any other city in the world.

Indirect Lighting in Hospitals.

Many hospitals in which the indirect method of illumination has been employed testify that this method reduces the amount of nervous and eye strain to which the patients are subjected at a time when they are least able to withstand it. This means much when a



INDIRECT LIGHTING IN HOSPITAL.

lowered vitality calls for all of the nervous force to assist in overcoming a disease.

In the accompanying illustration is shown a typical installation in a hospital ward made by the National X-Ray Reflector Company, Chicago, Ill.

The Gem Lamp-Cord Adjuster.

Utility and safety are the two principle characteristics of the Gem lamp-cord adjuster shown in the accompanying illustration. This adjuster is attached to the ceiling, entirely independent of wiring, at any desirable point away from the rosette, directly above where the lamp is wanted. The lamp

GEM LAMP-CORD ADJUSTER.

cord is connected to the adjuster by means of a strong cord at a suitable point, and it is wound around the adjuster drum, inside of which a powerful spring is inclosed with an automatic release which prevents any possibility of breaking the spring. At the point of connection to the lamp cord a porcelain insulator is used and a double loop of the cord is formed around this insulator in a way which prevents any wear of the insulation.

The adjuster operates in a manner similar to a window shade and the lamp may instantly be raised or lowered to any desired point. Its use eliminates the necessity of tying knots in the lamp cord or suspending it by means of a nail.

The Gem lamp-cord adjuster is manufactured by the Union Electric Manufacturing Company, Milwaukee, Wis.

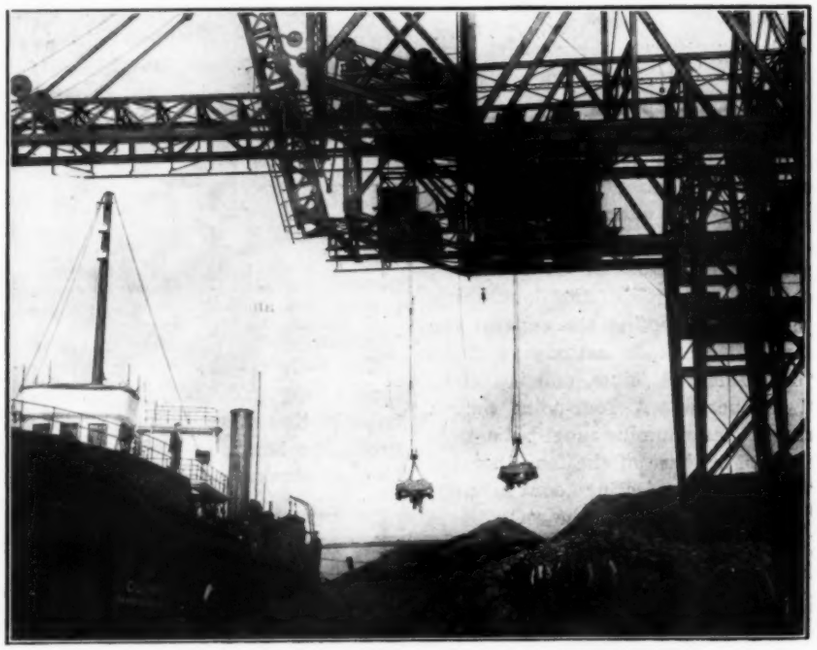
Machine for Making Dry Batteries.

A patent was recently granted to Willis E. Harmon, of Cleveland, O., and assigned to the Nungesser Electric Company, covering a machine for making dry batteries. The machine is quite an intricate one, as is indicated by the patent containing 135 claims. The machine greatly simplifies the work of filling in the materials into the zinc cans.

Ore-Boat Unloading Record Made by Lifting Magnets.

The lifting magnet is coming into more general use each year. First applications were restricted to steel plants but now foundries and many other industrial plants having magnetic materials, such as ore, castings, billets, scrap, etc., employ the lifting magnet. Less than a year ago the United States Steel Corporation used a magnet to recover a sunken cargo of steel wire, nails, etc., from the bed of the Mississippi River. The log sheet of the blast-furnace ore-dock superintendent of the Inland Steel Company shows a remarkable record for unloading an ore vessel made by two of this same Cutler-Hammer "Mississippi Type" magnets.

These two magnets in ten and one-half hours actual working time unloaded 4,000,000 pounds of pig-iron ore from the hold of the steamer *Erwin L. Fisher*. This vessel docked at 7:15 a. m. and cleared at 7:20 p. m. the same day. The magnets were operated from 7:35 in the morning until 6:35 p. m. (except for one-half hour at noon) maintaining an average lift per magnet of 3,427 pounds.



LIFTING MAGNETS UNLOADING CARGO OF PIG IRON.

The photograph of the magnets in operation show the awkward shapes and sizes of the ore which is difficult to handle except by magnets. The crane operator and men in the hold of the vessel are sheltered so that unloading can be accomplished regardless of weather conditions. The magnets used at this Indiana Harbor dock are Cutler-Hammer standard sixty-two-inch size circular magnets.

Wireless on Whaling Boats.

The whaling steamers *Tyee, Jr.*, *Fearless* and *Resolute*, owned by the Tyee Company of Seattle, Wash., are to be equipped with wireless telegraph apparatus. These will be the first whaling steamers to have wireless.

Current Electrical News

CANADA.

(Special Correspondence.)

OTTAWA, CAN., APRIL 1.—The management of the Montreal Light, Heat & Power Company announces a most progressive policy of extensions and improvements for the year 1911. Business is rapidly increasing in all departments of the company's lines, and in order to meet the heavy demands for electricity and gas, the directors have decided on an expenditure in the neighborhood of $1,000,000 to perfect the plant and service.

A new concern, to be known as the New Brunswick Hydro-electric Power Company, is seeking incorporation for the purpose of developing the valuable water powers on the Lepreaux and Nagaguadavic rivers in the county of St. John, N. B. The promoters believe they can successfully transmit power to the city of St. John and probably to St. Stephen, N. B., and Calais, Me.

The Hydro-Electric Power Commission of Ontario will call for tenders for the material for some eight or ten miles of transmission lines from a point on the Severn River to the towns of Midland and Penetanguishene. The tenders will also include material for necessary transformer stations. The object is to supply both the municipalities mentioned with hydroelectric power. Actual work of construction, both on the lines and the transformer stations, will be carried out by the Commission. It is hoped to be able to supply the towns with power by June 1.

In the House of Commons here the ministry was asked what quantity of power had been developed at the Niagara Falls under the Canadian law permitting the development of power; how much of this power could lawfully be exported to the United States; what quantity was being so exported, and what quantity was under contract for export. In reply the Government stated that the total power developed at Niagara Falls was 272,000 horsepower. Of the total power developed on Canadian side, 153,921 horsepower might lawfully be exported to the United States. Of this amount, however, only 72,628 horsepower was so exported during the last fiscal year.

By an amendment of the Ontario Hydro-Electric Power Commission Act, the way was paved for the supply of electric power to the farmers throughout the power zone in the province. By this amendment provision is made that any individual in a municipality, in which power is not being delivered, has only to notify the municipal council which must thereupon apply to the Commission for a supply of power. The Commission will then furnish an estimate of the maximum cost per horsepower and the cost of construction. The council must consider these at a special meeting, and, with the consent of the applicant or applicants, may then make a contract for power without submitting the matter to the ratepayers, issuing thirty-year debentures to pay for the plant, which must be repaid by the power users.

The statement made by officials, that by the middle of April the Canadian Light & Power Company, of Montreal, will be in a position to generate from 8,000 to 10,000 horsepower, and that such amount of power is already contracted for, marks an interesting stage in the development of Canadian hydroelectric projects. While the idea of developing power from the disused Beauharnois Canal was entertained as early as 1902, by those who are identified with the Canadian Power enterprise, yet it was not till 1904, that the company was incorporated. The carrying out of the project has called for a large amount of capital and a still larger display of confidence on the part of the syndicate. The present development provides an initial installation of some 25,000 horsepower, provision being made for increasing as required. The transmission line from the plant to the city of Montreal has been very substantially built, and the main receiving and distributing station will contain a large auxiliary steam plant as a provision against any possible interruption of the current generated by water power.

The bill in regard to the license of the Manitoba Power Company, which is seeking permission to operate in the province of Manitoba, has been granted by the Dominion Government, and very wide powers are given. Chief among the powers is the right to build and operate railway lines, hydroelectric plants, and all similar industries. In addition, it may acquire the charters of other companies of a similar nature. It is definitely understood that this company is prepared to take over the charters of several Manitoba companies in the carrying out of its plans. These include the operation of a system of radial railways from several points in Manitoba, which will also be used as central distributing points for electrical energy to be used for commercial purposes.

The first street cars in Western Ontario, to be operated by the municipally-owned power from Niagara Falls, were started out on March 27, from Preston, Ont., on the Preston-Berlin line, which is an auxiliary of the Canadian Pacific Railway. W.

MEXICO.

(Special Correspondence.)

The Cia. Minera de Natividad y Anexas, one of the most active mining properties in the state of Oaxaca, located in the Sierra Juarez District, has recently purchased from the Cia. Ingeniera, Importadora y Contratista, S. A., a new hydroelectric plant of 1,000-horsepower capacity. The installation of this plant has been found necessary on account of the increasing output of the mine and for the proper milling and cyaniding of the ore to be handled.

The mining company already has a power plant which was installed many years ago, but which was insufficient to meet the present demand, and so is now building a canal which will take the waters from the tail race of the old plant, and by using an available head of about 170 meters, can develop the 1,000 horsepower.

This new plant will comprise two 500-horsepower Pelton water wheels, which will be direct coupled to two 375-kilovolt-ampere Westinghouse alternating-current generators. The power house will also be equipped with two fifteen-kilowatt exciters, each of sufficient capacity to excite both generators; also a large switchboard for control of the machines and outgoing circuits. The transmission line will be in the vicinity of two miles at 2,400 volts, three-phase, and the power will be for motors in and about the mine and mill. This plant when completed will be one of the most modern in the country, and will be in full operation in a few months.

Fr some time past there has been in process of construction in Monterey a magnificent hotel which will cost in the vicinity of $1,000,000 when completed, and will doubtless be the finest hotel in the Republic of Mexico.

The owner of this hotel is Sr. Don Fernando Amcira and the engineer and architect is Sr. Don Gustavo Trevino. The furnishings and equipment of this hotel will correspond with the best on the continent and as a part of this equipment there will be installed an isolated electric plant to provide lighting and power for the building. A number of motors will be installed for running elevators, pumps, and numerous other devices and the equipment for the lighting of the building will be most modern.

The source of power will comprise two Westinghouse 100-kilowatt steam turbine outfits which will supply 250 volts with a three-wire arrangement for distribution.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Four existing electric lighting plants on Long Island came before the Public Service Commission, Second District, asking authority to merge into the Long Island Lighting Company. Oyster Bay and Amityville are now served by the Amityville Electric Light Company; the Sayville Electric Company supplies electric current in Sayville and the town of Islip; Northport and the town of Huntington receive electricity from the Northport Electric Light Company, and the Islip Electric Light Company intends to operate in Islip. This last named company has not begun the erection of its plant.

The new company also asks authority to issue $300,000 in capital stock, a first mortgage for $6,000,000, and issue at this time $370,000 in five per cent twenty-five year bonds under said mortgage.

The Commission reserved decision on the petition.

Attorney Frederick R. Swift appeared before the Commission on the petition of the Richfield Springs Electric Light & Power Company for authority to issue a mortgage for $100,000 and to issue now $50,000 in five per cent bonds to be secured by said mortgage.

With the petition of the Katonah Lighting Company for permission to exercise franchises in the towns of Poundridge and Lewisboro, Westchester County, it also asks authority to issue $45,000 in common capital stock to cover cost of building an additional power house at Bedford Hills.

The hearing concerning the type of cars to be run on the lines of the street-car lines in Albany was continued. Sixteen-foot single-truck cars are in operation on some lines and the operating company maintains that owing to financial difficulties it has been unable to make a change for the better. Alex Eckstrom, consulting engineer of the Delaware & Hudson Company, stated that besides some un-named considerations the only difficulty standing in the way of equipping the line with larger cars was one of expense. The taking of testimony was concluded and the case held open.

Henry Hemmens, counsel for the New York Edison company, put in additional testimony at a hearing before the Public Service Commission of the First District tending to show that the franchise relied upon by the Long Acre Electric Light & Power Com-

pany is invalid. The Long Acre Company has an application pending before the Commission for authority to issue stock and bonds to the amount respectively of $10,000,000 and $15,000,000. A dozen or more witnesses were put on the stand by Mr. Hemmens, who testified that they never heard of the American Electric Illuminating Company nor of the American Electric Manufacturing Company, from which the franchise rights claimed by the Long Acre Company are derived.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Milwaukee Northern Electric Railway Company has been authorized to issue $1,500,000 par value of five-per-cent bonds. These bonds are to be secured by the terms of a mortgage issued by the company to the First Savings & Trust Company of Milwaukee. The bonds are to be sold for money only and at not less than seventy-five per cent of the par value. The company has also been authorized to issue 4,000 shares of first preferred cumulative stock, and 6,000 shares of second preferred. The purpose of the issues of stocks and bonds is to supply the company with funds with which to purchase and retire an outstanding indebtedness of $2,500,000. The total assets of the company are given as $3,500,000.

The Manitowoc Electric Light Company has asked the Commission to recommend a fair rate for power users with varying horsepower loads, but who use their load for over ten hours per day. The company's present schedule offers same rate to power users regardless of the hours' daily use of the connected load or the nature of the load, whether off-peak or on-peak.

The City of Baraboo is considering the installation of a municipal lighting plant. The private plant now operating in Baraboo has never surrendered its franchise from the city and taken out an indeterminate permit from the state. The Municipality now owns and operates a waterworks plant the power for which is obtained from water power owned by the city. It is the intention of the city if the lighting proposition goes through to utilize the surplus water power now available. The town of Sun Prairie, which recently purchased the electric plant of the Sun Prairie Electric Light Company, has requested the Commission to go over the situation in Sun Prairie and recommend fair and equitable rates for lighting and power. Articles of incorporation of the Morgan Telephone Company, located in Oconto Falls, Wis., have been filed with the Secretary of State. The Great Northern Pail Company of Green Bay, Wis., has obtained a franchise from the village of Gillett which permits the company to do a street lighting and general lighting business in Gillett. The Black River Falls Municipal Electric Plant has filed a schedule of rates for power users as follows: Readiness to serve charge of fifty cents per month per active horsepower. First 100 kilowatt-hours, five cents per kilowatt-hour; second 100, four cents; third 100, three cents; over 300, two cents. Active horsepower shall consist of a fixed percentage of the nominal rated capacity of the motor or motors as follows:

Under 10 H. P. and only one motor	100%
Under 10 H. P. more than one motor	90%
Under 20 and over 10 H. P.	75%
Under 50 and over 20 H. P.	65%
Under 100 and over 50 H. P.	60%
Over 100 H. P.	50%

A complaint has been filed with the Commission by the Commercial Club of Superior against the Superior Water, Light & Power Company of that city. The complaint sets forth that the rates for water, gas and electricity as now charged by the company are excessive, unreasonable and bring to the company a return upon the property used and useful for the convenience of the public, which is unreasonably high. The complaint also alleges that the rates charged by the company to the city for public lighting are unreasonably low as compared with the rates charged to private consumers in the city.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

TO GENERATE 100,000 HORSEPOWER.—The Virginia Power Company has been incorporated with a capital of $1,000,000 and will begin at once the construction of hydroelectric plants on the New River in Virginia. Dr. J. J. Mott, of Statesville, N. C., has been purchasing waterpower sites for some time and is said to have turned over to the new company property capable of generating 100,000 horsepower.

POWER DEVELOPMENT NEAR COTULLA, TEX.—A syndicate headed by Dr. F. S. Pearson is behind a project to utilize the waters of the Nueces and Medina rivers for the operation of what will be one of the largest hydroelectric plants in the Southwest. In carrying out this project the same plan will be followed as that of the Mexico Light & Power Company in the installation of its hydroelectric plants at Necaxa, Mexico, and the construction of a series of water storage reservoirs. It is estimated by engineers who have made the surveys of the Nueces and Medina rivers that it will be possible to generate more than 100,000 horsepower and that by locating the dams for the reservoirs at favorable points there can be irrigated more than five hundred thousand acres of land. Power transmission lines will be constructed to San Antonio, Cotulla, Pearsall, Uvalde, Laredo and many other towns of that part of the state. D.

LIGHTING AND POWER.

(Special Correspondence.)

ALTO, TEX.—L. S. Atkins of Center, Tex., will build an electric light and ice plant here. Z.

KIRWIN, KAN.—This city contemplates a bond issue of $10,000 to establish an electric light plant. P.

MULBERRY, KAN.—This city is about to vote $8,000 in bonds to construct an electric light plant. P.

SUN PRAIRIE, WIS.—This city has voted $9,000 for the installation of an electric light system. P.

FRANCIS, OKLA.—The City Council has approved plans for an electric light plant which it will install here. D.

WASECA, MINN.—A vote will be taken in April on the issuance of electric light plant improvement bonds. P.

MOBRIDGE, S. D.—A franchise has been granted to the Mobridge Eleceric Light, Power & Heating Company.

ATLANTIC, IOWA.—Joseph H. Bartlanger Company has offered to build the municipal power and light plant for $49,000.

CRAWFORDSVILLE, IND.—The City Council has voted to install an ornamental lighting system throughout the business district. S.

SUSANVILLE, CAL.—The Lassen Electric Company has applied for a fifty-year franchise for supplying light, heat and power in this city. A.

FREMONT, NEB.—Contracts for the material to be used in the electrolier lighting system have been let. The total cost will be about $7,500.

BOSWELL, OKLA.—At a recent election held here $35,000 of bonds were voted for the installation of an electric light plant and system of water works. D.

MUSKOGEE, OKLA.—The Monticello Company has been incorporated with a capital of $100,000 to furnish electric power and build an electric railroad. P.

INDIANAPOLIS, IND.—An ordinance has been introduced in the council providing for the placing of all wires under ground within the central mile square. S.

ESCONDIDO, CAL.—The City Council has accepted the proposition of the Escondido Utilities Company to install and operate lights in this city for the next five years. A.

SUNSET, TEX.—The Lone Star Gas Company has entered into a contract with the City Council for the lighting of the main streets with natural gas for a period of two years. D.

SAN BERNARDINO, CAL.—The San Bernardino Valley Gas Company has proposed to the City Council, the proposition of a municipal power and electric lighting plant. A.

EAST TROY, WIS.—A franchise has been granted to the Milwaukee Light, Heat & Traction Company for the installation of an electric light system, to be in operation by July 1. C.

SCOTTSBLUFF, NEB.—The electric light plant here has been sold to F. H. Roberts, of Sterling, Colo. A new franchise has been granted to him and he will put in a $20,000 plant.

ALLIANCE, NEB.—The controversy between the city of Alliance and the Electric Light & Power Company has finally been settled by the city taking over the plant for $55,000.

LULING, TEX.—At a meeting of the City Council a franchise was granted to the Luling Electric Light & Power Company to erect, maintain and operate an electric light plant in the city for a term of twenty years.

STOUGHTON, WIS.—Stoughton has bonded itself to the amount of $18,700 to buy the waterpower rights and property of the Stoughton Mills Company as an addition to the municipal electric light and power system.

HOLLIS, OKLA.—The Hollis Cotton Oil, Light & Ice Company has been incorporated for $75,000 by C. Burton, R. K. Wooton, J. T. Aust, of Chickasha; W. A. Wilheld, of Quannah, Texas; and W. N. Hays, Norman, Okla.

MOBERLY, MO.—T. F. Fulkerson of Trenton, Mo., and William Maasey have purchased the plant of the Moberly Gas & Electric Company. Mr. Fulkerson will be president of the company and Mr. Maasey secretary-treasurer. Z.

PENN YANN, N. Y.—The Yates Electric Light & Power Company has conferred with the village board regarding the purchase of the local lighting plant. The object is the consolidation of plants for more economical operation.

JEWELL, IOWA.—The residents of Jewell, it is reported, have subscribed for $4,000 and outside parties $8,000, making a total of $12,000 in stock for the erection of an electric light plant which is being promoted by W. H. Grover of Ames, Iowa. Z.

FARMINGTON, ILL.—The Farmington Light & Power Company has been organized and will supply current for power and lighting. The capital is $30,000 and the incorporators are T. Bass, W. M. Andrews and H. E. Worden, all of Farmington.

FT. WAYNE, IND.—The work of electrifying the Bass foundry plant is progressing under the supervision of Chief Electrician Irvin James Troy. Every department of the big concern will be operated by electric power generating its own current. S.

MEMPHIS, TENN.—The Spring River Power Company, which is composed of capitalists of Memphis, St. Louis and Jonesboro, Ark., has filed articles of incorporation with headquarters at Jonesboro. The capital stock is $100,000.

BRIDGEPORT, CONN.—Work is progressing rapidly on the improvements being made in the plant of the Connecticut Power Company. Among other things two 300-horsepower units are being taken out and two 1,000-horsepower machines installed.

ST. AUGUSTINE, FLA.—A stock company is to be organized with a capital of $50,000 by J. G. Fancy of the American Diesel Engine Works and D. O. Rodgers of Wauchula. A power house will be erected to furnish current for lighting and power.

COLUMBIA, CITY, IND.—The Ft. Wayne Electric Works has been awarded a contract to install motors, transformers and electrical machinery in the city lighting plant. The plant is to be enlarged so as to furnish day current for power and various other purposes. S.

COBALT, ONT.—The Northern Ontario Light & Power Company of Cobalt, with a capital of $7,500,000 has been chartered and will take over the light and power system of Cobalt and Haileybury. It has been given wide powers to acquire and develop other public utilities.

MARQUETTE, MICH.—The Cleveland Iron Company has decided upon the location of its proposed big power dam on the Carp River, between Negaunee and Marquette. The power station, at which will be developed 7,000 horsepower, will be erected near Mount Messnard. Z.

PORTLAND, ORE.—The Husum Power Company's plant of 200-horsepower capacity, which lights the towns of White Salmon, Bingen and Husum, has been sold to the Pacific Power & Light Company, of Portland, Ore., which operates plants at Hood River, Walla Walla, the Dallas and North Yakima. A.

MINNEAPOLIS, MINN.—The Spooner bill which provides for a State Commission to control the lakes and rivers of Minnesota, has passed the lower house of the legislature. If the bill becomes a law operators must pay to the state from ten cents to $2.00 a horsepower in proportion to the value of the franchise. Z.

RALEIGH, N. C.—The Yadkin River Power Company has been chartered with a capital of $4,000,000 to generate and supply electrical power. It is expected that the company will take over the Blewitt Falls power plant near Rockingham. Should this be done extensions and improvements will be made.

PORTLAND, ORE.—President Josselyn, of the Portland Railway, Light & Power Company, announces that his company plans to spend $4,000,000 in the development of electrical energy plants so as to place the company in a position to furnish electrical power in a large district in Oregon and Washington by 1914. A.

GRIFFIN, GA.—The Light, Water and Sewerage Commission has closed a contract with the Central Georgia Power Company by which that company will furnish electrical power to Griffin. The present electric light plant will be done away with and the city expects to save about fifty per cent on operating expenses.

HARRISBURG, PA.—The Mountain Electric Light, Heat & Power Company, which has extensive operations in Huntingdon County, below Birmingham, and eastward as far as Hollidaysburg, has applied for a charter here for the incorporation of the above company, the object being to furnish electricity for power, heat and light, in Logan township, Blair County.

NEWARK, N. J.—The Northwestern Land & Irrigation Company has incorporated for the purpose of operating electric plants and for maintaining telephone and lighting lines. The main office of the company will be at Greystone Park. The incorporators are Frank E. Wiggins, of Brooklyn; Lowrey H. Lighton, of Greystone Park, and Norman E. Wiggins, of Brooklyn.

HAMMOND, IND.—The Northern Indiana Gas & Electric Company of this city has been incorporated with $5,000,000 capital stock, of which $1,000,000 is preferred and $4,000,000 common. The incorporation includes a merger of South Bend & Mishawaka Gas Company, Michigan City Gas & Electric Company, South Shore Gas & Electric Company, Indiana Harbor & East Chicago Electric Company, Plymouth Electric Company, and Whiting Electric Company. Philadelphia capital is behind the merger.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has been incorporated by P. S. Scales of San Mateo, J. H. Sandford and Rudolph Spreckles of San Francisco, Frank Harrold of Fruitvale, and Claus Spreckles, of New York. It is announced that this corporation is, in a way, a reorganization of the Municipal Light & Power Company which was part of the Spreckles Estate, but under the present plans, the latter corporation will be taken out of the Spreckles estate and enlarged. A.

MUNCIE, IND.—A declaration has been filed with the Secretary of State merging the Redkey, the Dunkirk, the Eaton Electric Companies, and the Hartford City Lighting Company with the Muncie Electric Company in a manner which provides for an enlargement of the powers of each concern permitting any one of the companies to supply water, heat, light and power in any city of the state. The plant is to furnish their subsidiary companies with current from the Muncie power house which is owned and operated by the American Gas & Electric Company. S.

ELECTRIC RAILWAYS.

(Special Correspondence.)

DULUTH, MINN.—The Twin City Rapid Transit Company has commenced the rebuilding of the incline railway. The cost will be $40,000. C.

HASTINGS, MINN.—A franchise has been granted to the St. Paul Southern Electric Railway Company to construct a line through the town. C.

DES MOINES, IOWA.—The Fort Dodge, Des Moines & Southern Railway Company is planning the expenditure of $500,000 in the improvements of its lines. C.

ST. PAUL, MINN.—A franchise has been granted to the St. Paul Railway Promotion Company for the construction of an electric line along Pleasant Avenue. C.

COLORADO SPRINGS, COLO.—It is stated that the construction of an electric line between Manitou and Cripple Creek is contemplated. The line will be several miles shorter than the present one and will have only a moderate grade.

HOUSTON, TEX.—Plans are on foot for the construction of an electric railway to run from this city to the turning basin in Buffalo Bayou. The right of way for the proposed line is being secured. Harvey T. D. Wilson of Houston can give information. D.

IOWA CITY, IOWA.—The Iowa City-Ottumwa Interurban Railway Company has decided to construct its proposed line thirty-five miles in length during the coming summer to Keota or Sigourney. The contract has been let to the Arnold Construction Company of Chicago at $2,196,000. C.

SPRINGFIELD, ILL.—The City Council has granted a franchise to the Springfield Consolidated Street Railway Company to lay a double track a mile long on South Spring Street. This line is used also by the Illinois Traction System in entering Springfield from St. Louis and Southern Illinois terminals. Z.

WATSONVILLE, CAL.—The defunct Watsonville Transportation Company's holding here, consisting of rolling stock, power plant, a four-mile track from Watsonville to Monterey Bay and a franchise and realty has been sold to J. W. Forgeus of San Francisco for $22,000. The line will probably be rehabilitated very soon.

INDIANAPOLIS, IND.—A new electric interurban line is proposed from this city to Seymour, Ind., and to be erected by what will be known as the Indianapolis & Seymour Traction Company. Among those mentioned as being connected with the proposition are M. L. Clawson, of this city, J. B. Dill and A. G. Kelly, of Greenwood.

DALLAS, TEX.—It is reported that Stone & Webster of Boston will build an interurban line from Dallas to Waxahachie that is intended to be in active operation by the fall of 1911. The line is to be approximately thirty miles long and will cost about $1,000,000. The roadbed is to be of the best and the rolling stock of the latest pattern.

SOUTH BEND, IND.—The officials of the South Bend and Logansport Traction Company, now building a line from Logansport to South Bend, have been granted six months further time to complete the line into South Bend as the franchise time is almost ended. The company officials showed good reason for not having opened the line before this. S.

LANSDOWNE, PA.—Lansdowne Council has granted the Terminal Street Railway Company the right to build a trolley line through the borough. Provisions in the bill require that the company begin work on the road within two months and pay the borough the sum of $15,000 cash to be used in rebuilding the roadway which it will traverse. At the expiration of five years the trolley company will maintain the streets perpetually.

WHEELING, W. VA.—The Steubenville, Wellsburg & Wirton Railway Company, recently chartered with a capital of $10,000, has increased its capital to $1,300,000. It is the present intention to run the road from Towson to Marble Hill. The directors of the company are: President, J. Alexis Shriver; vice-president, William H. Wight; secretary and treasurer, James S. Nussear; William H. Griffin, Charles E. Rieman and David G. McIntosh, Jr.

NEW IBERIA, LA.—Articles of incorporation have been drawn up for the formation of a company known as the "Louisiana Company," which will have for its object the furtherance of railroad, both steam and electric, construction throughout this section of the state. The company is capitalized at $1,000,000 with shares of 10,000 at the par value of $100 each. The board of directors are George W. Dallas, J. W. Eckart, John R. Taylor, V. J. Smith, R. S. McMahon, M. W. Fisher, with George W. Dallas president, John R. Taylor vice-president, V. J. Smith secretary-treasurer.

MILWAUKEE, WIS.—Work on the line of the Badger Railway & Light Company from Whitewater to Elkhorn will begin at once according to H. B. Kanischulte, president of the company, which has just increased its capital from $10,000 to $400,000. The line to Lake Geneva will be built as soon after as is possible. Two-thirds of the work is done, the right-of-way being obtained and the grading completed. The road will be twenty-two miles long. Victor Lachmund of Chicago is vice-president and G. Pickhardt of Milwaukee secretary and George F. Savoy treasurer. Z.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

BRUCE, MINN.—L. Chase and others are planning the construction of a telephone line. P.

UKIAH, CAL.—H. Olsen has been granted a franchise for a telephone system in the First Road district.

BACKUS, MINN.—The Backus Rural Telephone Company is planning extensive improvements and extensions. P.

LONG PRAIRIE, MINN.—George Langton and others, of Hartford, are organizing a company to build a telephone line here.

SHOBONIER, ILL.—New lines will be built by the reorganized Farmers' Telephone Company, of which Edward Blankenship is president. Z.

HILLSBORO, ILL.—The Montgomery County Telephone Company has asked for a twenty-five-year renewal of its franchise which has yet four years to run. Z.

OKTAHA, OKLA.—The Oktaha Independent Telephone Company has been incorporated for $1,000 by J. C. Brady, H. N. Williams, John Newberry and others.

ROSEDALE, OKLA.—The Rosedale Telephone Company has been incorporated by John T. Youkum, of Byars, T. D. Luper, of Paoli, and L. L. Youkum, of Rosedale.

HYDRO, OKLA.—The Hydro Southwestern Telephone Company has been incorporated by Jacob Greenson, D. M. Dill and A. W. Oldham with a capital stock of $500.

KINGFISHER, OKLA.—The Wandell Telephone Company has been incorporated for $500 by J. L. Faxon, J. A. Caylor, C. C. Wells, W. C. Rudd and T. J. Eaton, all of Kingfisher.

DANA, IND.—The Citizens Mutual Telephone Company has increased its capital stock and is in the market for new equipment and material for improving and extending its plant. S.

LIVINGSTON, CAL.—E. D. Thomas, president of the Livingston Realty Company, is planning a telephone system for this town. His plans will probably be announced in detail within a few weeks. A.

WINTERS, TEX.—The Winters & Ballinger Rural Telephone Company of Winters has been incorporated with capital stock of $15,000. The incorporators are J. O. Harrell, R. D. Colwell, and Elgin Davidson. Z.

CHELSEA, OKLA.—The Riggs Chapel Rural Telephone Company has been incorporated by W. H. Sutherin, W. J. Strang, L. L. Russell, R. A. Bailey, and W. W. Statis, all of Chelsea. The capital stock is $2,500.

LITTLE YORK, ILL.—The Little York Mutual Telephone Company has been incorporated with capital stock of $5,000 to do a general telephone and telegraph business. The incorporators are Willis Wiley, J. E. Porter and C. W. Cooper. Z.

OKLAHOMA CITY, OKLA.—The Oklahoma Home Telephone Company has been incorporated with a capital stock of $5,000 by C. E. Bishop, R. S. Ross and W. L. Maupin. The purpose of the company is the improvement of independent service over Oklahoma.

EVANSVILLE, IND.—Representatives of independent telephone interests in Kentucky, Indiana and Illinois, have asked for a franchise to enter this city to build and operate an independent telephone plant. The petitioners promise to pay the city ten per cent of the gross earning and expend a large amount of money in the installation of a new plant. S.

BELLPOINT, W. VA.—The Citizens' Telephone Company has been incorporated to operate a telephone line between points in Greenbrier and Summers counties. The authorized capital is $5,000 and the incorporators are W. H. Taylor, J. W. Shumate and W. S. Taylor, of Bellpoint; O. L. Foster, of Hinton, W. Va.; J. L. McDowell, of Bertha, W. Va., and C. G. Ramsey, of Forest Hill, W. Va.

VIRDEN, ILL.—Charles H. Snell has formed a stock company to take over the Virden Telephone Exchange and hereafter the business will continue under the name of the Virden Telephone Company. The officers of the new company are Charles Snell, president and manager; U. G. Tucker, vice-president, and J. A. Stice, secretary. There will be a good deal of new work and repairs during the season. Z.

ROSWELL, N. M.—It is stated that the Colorado Telephone Company, which has just acquired all of the local telephone exchanges and long-distance lines of independent companies in the Pecos River Valley in New Mexico, will spend more than $100,000 in coppering all the lines of the merged system, the construction of a new line to Lincoln and in the erection of new station buildings. The exchanges included in the sale were those at and between Melrose, Fort Sumner, Texico, Clovis, Portales, Farwell, Hagerman, Roswell, Artesia and Lake Arthur. The negotiations for the sale of the telephone system at Carlsbad by A. A. Luzzy and associates to the Colorado Phone Company are still pending. The total consideration in volved in the transactions, exclusive of the pending Carlsbad deal, was about $300,000. The purchasing company is a Bell concern. D.

ELECTRICAL SECURITIES.

Although there has been a greater activity in securities during the past week than the week before, the volume was still small and indicated that investors were still awaiting developments in the Supreme Court decisions. A decision either way would materially benefit conditions. Money is at present cheap and American securities are increasing in favor abroad to a considerable degree.

Fuller & Company, New York, announce that the unsold portion of $510,000 of seven-per-cent cumulative preferred stock of the Crocker-Wheeler Company, of Ampere, N. J., recently offered for sale by them at 102 as of April 1, 1911, has been fully subscribed.

The Guaranty Trust Company has purchased $4,000,000 thirty-year five-per-cent bonds of the Great Falls Power Company, of Montana. The company has developed on the Missouri River at Great Falls 47,000 horsepower and has transmission lines to Butte and Anaconda, at which points the principal market for power is located. The company also owns approximately 100,000 horsepower undeveloped or partly developed.

At the adjourned special meeting of the Northern Ohio Traction & Light Company, at Akron, Ohio, stockholders approved the issue of $1,000,000 preferred stock offered to stockholders at ninety-seven and one-half. Proceeds will be used for the construction of a combined steam and hydraulic power station to supply electric power to Akron and to take care of the growing demand for power.

The Philadelphia Stock Exchange has been notified that no further formal extension of time will be given to the stockholders of the Philadelphia Rapid Transit Company to deposit their stock under terms of the voting trust agreement. A statement of the number of shares deposited up to and including April 3 will be filed with the secretary of the Stock Exchange.

Some weeks ago, Lee, Higginson & Company, Boston, purchased an issue of $1,250,000 five-per-cent bonds of the Bell Telephone Company, of Canada, maturing in 1925. These bonds have been offered in London and Montreal, and were more than two and one-half times oversubscribed.

DIVIDENDS.

Associated Gas & Electric Company; preferred quarterly dividend of one and one-half per cent, payable April 15.

Boston Suburban Electric Company; preferred quarterly dividend of $1.00 per share, payable April 15.

Commonwealth Gas & Electric Company; preferred quarterly dividend of one and one-quarter per cent, payable April 15.

Public Service Corporation of New Jersey; quarterly dividend of one and one-half per cent, an increase of one per cent annually, payable March 31 to stock of record March 31.

United Light & Railways Company; first preferred quarterly dividend of one and one-half per cent; second preferred of three-fourths per cent, both payable April 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Apr. 3.	Mar. 27.
Allis-Chalmers common	7⅞	7⅞
Allis-Chalmers preferred	30¼	31
Amalgamated Copper	63	63
American Tel. & Cable	*80¾	*80¾
American Tel. & Tel. (ex-dividend)	144¾	146⅝
Brooklyn Rapid Transit	77⅝	78¼
General Electric	148¼	147⅜
Interborough-Metropolitan common	18¾	18⅝
Interborough-Metropolitan preferred	53	53
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	92	90½
Mackay Companies (Postal Telegraph and Cables) preferred	76½	75⅞
Manhattan Elevated	136½	135¼
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	51	52⅝
U. S. Steel common	77⅞	78¼
U. S. Steel preferred	118¾	119
Western Union	73	72¼
Westinghouse common	66	66
Westinghouse preferred	119½	120½

*Last price quoted.

BOSTON.

	Apr. 3.	Mar. 27.
American Tel. & Tel. (ex-dividend)	144¾	146⅝
Edison Elec. Illuminating	283	284
General Electric	148¼	147⅜
Massachusetts Electric common	17¼	17½
Massachusetts Electric preferred	87½	87
New England Telephone	140	144
Western Tel. & Tel. common	20	20⅛
Western Tel. & Tel. preferred (ex-dividends)	93	92½

PHILADELPHIA.

	Apr. 3.	Mar. 27.
American Railways	44	44
Electric Company of America	12	11⅞
Electric Storage Battery common	52½	54
Electric Storage Battery preferred	52½	54
Philadelphia Electric	16⅛	16⅛
Philadelphia Rapid Transit	19½	19¾
Philadelphia Traction	84	84⅛
Union Traction	47	47¾

CHICAGO.

	Apr. 3.	Mar. 27.
Chicago Railways, Series 1	90	89
Chicago Railways, Series 2	24½	23½
Chicago Subway	4½	4½
Chicago Telephone	122	122
Commonwealth Edison	128	128
Metropolitan Elevated common	23	23¼
Metropolitan Elevated preferred	69	68½

PERSONAL MENTION.

F. R. MOTT has been elected general manager of the Bell Telephone Company of Missouri. James K. Wass has been re-elected auditor, a position which he has held for twenty-five years.

R. F. PIER, foreman of the transformer department of the Canadian General Electric Company, Peterboro, Ont., has left that company to accept a similar position with the Triumph Electric Company, of Cincinnati, O.

ALDIS E. HIBNER, formerly assistant power engineer of the Toronto Electric Light Company, Ltd., of Toronto, Can., has resigned in order to accept a position with the Livingston Niagara Power Company, of Avon, N. Y. In his new capacity Mr. Hibner has charge of the sale of power over the entire system of the company.

C. M. GODDARD, the retiring secretary of the Underwriters' National Electric Association, was presented with an engrossed copy of resolutions of esteem which were enacted at the final meeting of the body on March 23. Mr. Goddard has been secretary of the association for twenty years and during that time has enthusiastically devoted himself to the work of raising the standard of safety of electrical installations. The National Electric code as it stands at present is largely the result of his efforts.

W. N. KEISER, electrical engineer with the Union Electric Company, of Dubuque, Ia., and secretary of the Iowa Electrical Association, is going to sever his active connections with the central-station industry, having accepted a position with the G. W. Parsons Company, Newton, Ia., manufacturers of contractor's machinery. As this change does not become effective until May 1, Mr. Keiser will be in attendance at the forthcoming convention of the Iowa Association. Mr. Keiser is one of the most popular members of the electrical fraternity in Iowa and his retirement from this field will be regretted by his many friends.

A. H. WHITESIDE, who was for over four years manager of the power and electrical department of the Allis-Chalmers Company, in charge of sales and engineering, has accepted a position as assistant sales manager with the Triumph Electric Company, of Cincinnati, O. Mr. Whiteside was previously southern manager of the Sterling Boiler Company, with headquarters at Atlanta, Ga. He is a member of the Engineering Club of New York, and an associate member of the American Institute of Electrical Engineers. Mr. Whiteside is very well known in electrical circles and has an extensive knowledge of power and transmission engineering. He assumed his new duties on April 1.

ALTON EARLE WILLIAMS has been elected secretary-treasurer of the Colonial Electric Company of Warren, O., where he will be in charge of all the incandescent lamp sales activities of that company. Mr. Williams has been connected with the general offices of the National Electric Lamp Association in Cleveland since the latter part of 1909, prior to which he was sales manager of the Brilliant Electric Company. Mr. Williams' work during the past few years has brought him into personal contact with many western central station men and also with prominent electrical jobbers all over the United States. His training and acquaintance will thus enable him to handle the commercial problems of the incandescent lamp business from a broad and comprehensive standpoint.

OBITUARY.

WILLIAM CARPENTER WOODWARD, who was connected with the Narragansett Electric Lighting Company, of Providence, R. I., died in that city on March 25. Mr. Woodward was a member of the American Institute of Electrical Engineers and several local clubs and societies.

LOUIS A. LURIENNE, for fifteen years the representative of the French Cable Company in the United States and Canada, died on March 25 in Paris, France. For half a year he had been suffering from a complete nervous breakdown, and was attended by specialists here and in France, where he went three months ago. Mr. Lurienne was fifty-two years old and unmarried. He was an officer of the French Legion of Honor, and was formerly an officer of the French Government Telegraphs. Burial was at Havre.

CHARLES W. HUNT, president of the C. W. Hunt Company, of West New Brighton, N. Y., died March 27 at his home on Grymes Hill, Staten Island. Mr. Hunt was born at Candor, N. Y., seventy years ago. He learned the iron worker's trade early in life. He had been in business in Richmond for many years. He was past president of the American Society of Mechanical Engineers, a member of the New York Chamber of Commerce, of the New York Electrical Society, of the New York Mining Institute, of the Railroad Club, and ex-president of the Staten Island Chamber of Commerce.

NEW INCORPORATIONS.

YONKERS, N. Y.—The Westchester Electrical Equipment Company was recently incorporated with a capital of $10,000 for the purpose of carrying on electrical work. The incorporators are L. L. Fletcher, Wm. N. Barlow and Charles W. Boote.

INDIANAPOLIS, IND.—The Hydraulic Drive Company has filed articles of incorporation, capitalized at $50,000. The object of the corporation is to manufacture machines, mechanism and devices for the transmission and regulation of all kinds of power. Fred H. Cheyene, Chas. S. Walker and Thos. H. Endicott are directors. S.

NEW YORK, N. Y.—The Alpha Electrical Supply Company has been incorporated to manufacture and deal in electrical goods of all kinds. The capital is $10,000, and the directors are John J. Wolpert, Ernest Block, and Anthony Bauer, all of Brooklyn.

ALEXANDRIA, IND.—The American Insulating Company has been incorporated with a capital stock of $600,000 to manufacture insulating and fireproofing material. The directors are: F. K., F. O. and J. L. Sawyer, C. L. Bayne, B. G. Slaymaker, F. M. White and J. H. Boogher.

MANHATTAN, N. Y.—The Semi-Dry Battery Company, which will manufacture batteries and electrical goods has been incorporated with a capital of $50,000. The directors of the company are Elias D. Smith of Elizabeth, N. J., Albred L. White of New York and A. W. Fully of Brooklyn.

BEDFORD, IND.—The Southern Equipment & Supply Company was recently organized for the purpose of assisting in the development of the Bedford stone industry. It will handle general construction work, with particular attention to electrical construction and maintenance and the application of electric drive to quarrying and mill machinery. A complete line of quarry and mill supplies, both electrical and mechanical, will be carried.

INDUSTRIAL ITEMS.

THE ECONOMY SWITCH BOX & MANUFACTURING COMPANY, Cleveland, O., is mailing booklets describing its economy switch boxes and plates. Each of the boxes listed is illustrated and prices are given throughout.

THE NATIONAL ELECTRIC COMPANY, Detroit, Mich., a new electrical supply house which has been established at 268 Cass Avenue, is desirous of receiving quotations and catalogs of electrical supplies and machinery from manufacturers.

MAC GOVERN, ARCHER & COMPANY, New York, N. Y., list in their March bulletin a large amount of electrical and steam machinery, power-house equipment, cars, etc. The company is also in the market for second-hand steam and electrical machinery.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., announces that J. F. Nisbet, publicity manager, has been selected to take charge of the publicity and advertising department of the Triumph Ice Machine Company. These two departments were formerly operated independently of each other, but have now been combined.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has published a booklet, entitled "Electric Meters: How to Read Them." As the title suggests, the booklet is intended as an instruction in the reading of watthour meters for the layman. It is written in a popular style, easily understood by anyone.

THE FEDERAL MINIATURE LAMP COMPANY, Cleveland, O., manufacturers of miniature and candelabra incandescent lamps, will open their new general offices at 612 Hippodrome Building early this month. Walter B. Armstrong is president and general manager of the company and will be assisted by B. F. Whelan, formerly of the Buckeye Electric Company.

ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT,, Berlin, Germany, has issued a catalog dealing with search-light apparatus for light-houses, ships and similar installations. All the necessary accessories are described, including some interesting novelties. A Zeiss reflector is used in this apparatus. A number of special types have been designed for naval and military use.

THE NATIONAL INDIA RUBBER COMPANY, Bristol, R. I., announces that a change has been made in its agency arrangements for the Pacific Coast and that in the future a complete line of rubber-covered lamp cords, wires and cables will be carried at its branch office No. 155 New Montgomery Street, San Francisco, Cal. The office will be in charge of Otis & Squires.

THE DOW CHEMICAL COMPANY, Midland, Mich., manufacturer of bleaching powder, soldering flux and various chemicals, is prepared to furnish carbon tetrachloride in large quantities at a reduced price. The recognition of the valuable properties of this chemical for fire extinguishing is creating an increasing demand for it. It is especially valuable around telephone switchboards.

THE WATERBURY COMPANY, New York, N. Y., has published a reprint of an article appearing in the *Electric Railway Journal* on the installation of seven submarine cables for the Union Railway Company of New York. These high-tension submarine cables were laid at one time, and it is said that this is the largest simultaneous installation that has ever been made in that section of the country.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., recently shipped the Pennsylvania Water & Power Company, McCalls Ferry, Pa., a three-phase, 10,000-kilowatt, 11,000-volt water-wheel-driven generator designed to operate at a speed of ninety-four revolutions per minute. The shipping weight of the alternator was approximately 700,000 pounds, and fifteen cars, many of exceptionally large capacity, were required for its transportation.

THE BLOCKI-BRENNAN REFINING COMPANY, 11 North La Salle St., Chicago, has published a very interesting catalog de-

voted to Carb-Oxide paint. This paint is peculiarly applicable for metal and other surfaces where there is continuous exposure to the atmosphere or to deleterious fumes or gases. The paint has been applied in boiler rooms, on smoke stacks and to bridge structures with perfect satisfaction. Full information may be secured upon application to the company.

MASCHINENFABRIK OERLIKON, Oerlikon bei Zürich, Switzerland, has issued several pamphlets covering small sizes of single-phase commutator motors, inclosed controllers for small motors and a line of small motors especially built for clock makers. The regular monthly bulletin for December last contains a description of alternating-current generators with vertical axis for low frequencies.

THE BRUCE-MACBETH ENGINE COMPANY, Cleveland, O., recently mailed an attractive bulletin dealing with the subject of gas engines for electric lighting, pumping and all other power purposes, using for fuel either artificial, natural or producer gas or gasoline. A table included in this publication gives the cost of generating power with each of these mediums, and from the figures a number of very interesting points may be deduced. Half-tone illustrations of the assembled engines and of its parts are shown, together with several diagrams.

THE BOSCH MAGNETO COMPANY, New York, N. Y., makes a feature in the March issue of *The Bosch News* of a review of the year's automobile victories, speaking especially of the magneto equipments of the cars. An interesting illustration shown in this number is reproduced from a photograph of the battleship *Pennsylvania* taken just as Ely, the aviator, was in the act of alighting on it with his biplane. This picture shows the most interesting stage of the first successful flight of an aeroplane to and from a warship. Needless to say, the engine of the biplane was equipped with a Bosch magneto.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, Mansfield, O., has distributed Bulletin No. 1031 on squirrel-cage polyphase induction motors. Commencing with a description of the general advantages of induction motors for industrial drives, it devotes special attention to a description of the type A Ideal motors. It shows a new method of connecting the rotor bars to the end rings and also describes their new self-oiling, self-aligning bearing. The bulletin is illustrated with curves showing the temperature rise of the motors and also curves showing the efficiency, power factor, regulation, torque, etc., of this type of motor. The bulletin also contains general formulas for determining the amperes, volts, watts, etc., for both two and three-phase motors.

THE JAYNES COMPANY announces that its factory which was being equipped in Irvington, N. J., for the manufacture of the Jaynes insulating joint, was completely destroyed by fire on February 21. This company has now decided to locate in Newark, N. J., and its new plant will be in operation the early part of May. The Jaynes insulating joint is approved by the National Board of Fire Underwriters, and combines great mechanical strength with electrical efficiency. These joints are built on the principle that compression is the secret of mica insulation for high voltages, and it is by this means that these joints are enabled to stand the severe requirements of the National Board, at the same time possessing a mechanical strength which enables the user to handle them practically the same as if they were pipe fittings.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburg, Pa., has received an order from the Kern River Oilfields of California, Ltd., calling for the largest number of oil-well motors ever placed in this territory at one time. The order is for early delivery and calls for one hundred motors which will be used in the Kern River field for pumping and cleaning the great number of oil wells on the properties of the above company. The motor adopted is of the back-geared type and a pulley on the countershaft drives the main belt. The motors are of the alternating-current, varying-speed, continuous-service, induction type and will operate on a three-phase, sixty-cycle, 440-volt circuit. The motor windings are so arranged that by the simple operation of the switch handles two economical working capacities are obtained. The motors will operate continuously at ten-horsepower output with high efficiency on pumping service; for cleaning wells, they will easily develop thirty horsepower on intermittent service.

THE ELECTRICAL ENGINEERS EQUIPMENT COMPANY, 10 North Desplaines street, Chicago, has published Catalog No. 2, devoted to electrical fittings for power plants. This catalog is worthy of a prominent place in the library of every civil, electrical and mechanical engineer. It is particularly valuable to engineers having to do with outside construction and specializes on transmission material. Special information is given respecting instructions for installing cable bells and there is a new idea on every page. Of very great value is the engineering information given in the back of the catalog. This includes tables for the determination of the currents in three-phase circuits, based upon various power factors; easy methods for finding the amperes per phase in three-phase, two-phase and single-phase circuits; bus spacings, for voltages from 250 volts to 160,000 volts, giving the distance between centers of busses, the minimum distance between opposite live parts, and the minimum distance between live parts and ground; table of sparking distances in air between opposed sharp needle points for various effective sinusoidal voltages, in inches and centimeters; approximate amperes at full load of standard speed induction motors; weight per lineal foot of standard sizes of rectangular and flat drawn copper bars; carrying capacity in amperes of copper tubing; circular millage and carrying capacity of flat bus bar copper; spacing of conductors; data for wrought iron pipe; data on solid copper wire and copper cable; and numerous handy tables and formulas. Copies of this catalog may be secured by engineers upon request.

THE GENERAL ELECTRIC COMPANY has just issued Bulletin B 3038, entitled "Electricity on the Farm." The bulletin is divided into brief chapters, each covering a specific use for electricity on the farm, the various descriptions of motor applications being accompanied by illustrations of electrically operated farm machinery in actual service. The section covering barn and field machinery includes description and illustrations of motor operated hay hoist, ensilage cutter, thresher, grist mill machinery, etc., while the chapter on electric drive for dairy apparatus shows the use of motor driven vacuum pumps for the operation of vacuum milking and cattle cleaning outfits, motor driven separators and churns. Bulletin No. 4817 describes the company's seventy-five-horsepower direct-current commutating-pole railway motor which represents the latest construction in this class of apparatus. For the purpose of enabling a customer to select the motor best suited to his needs, the General Electric Company furnishes a form for the customer to fill out and return for the purpose of showing the character of the service which it is desired to operate. A sample form is included in this bulletin. In Bulletin No. 4815, also recently issued, are illustrated and described continuous and alternating-current motors, and apparatus for controlling them when applied to machine-tool operation. The publication contains also illustrations of the motors installed on drills, saws, shapers, milling machines, slotters, planers, lathes, etc.

THE MINNEAPOLIS STEEL & MACHINERY COMPANY, Minneapolis, Minn., announces that its downtown office has been moved from the ground floor of the Corn Exchange, where it has been for several years, to 914 Flour Exchange. The mechanical department in this office is represented by F. J. Rose and the structural department by Daniel Agnew. A number of changes have also been made in branch offices. The Butte office has recently been changed to 319 Electric Building, Butte, Mont. The Denver office was changed several weeks ago to 902-3 Gas and Electric Building, Denver, Colo. At El Paso, Tex., the office of the structural department was discontinued this winter, and a San Francisco branch established with the firm of Braun, Williams & Russell. A branch is also in operation now at Spokane, Wash., 225 Paulson Building, as is also a Seattle branch. The branches at Seattle, Spokane, Butte and Denver are now primarily devoted to the work of the structural department, while the Omaha branch, the Dallas, Tex., office, the San Francisco and Los Angeles branches devote their energies to the mechanical department. At Salt Lake City are located offices of the mechanical department and of the structural department. With these strong outposts all over the West, the Minneapolis Steel & Machinery Company has placed itself in a strong position for extending the trade of its growing line of iron and steel products. The plant of the company at Lake Street and Minnehaha Avenue, Minneapolis, now consists of eight large buildings occupying sixteen acres of ground. It is manufacturing Corliss engines which it has been turning out with success for over twenty years. The Muenzel gas engine made in sizes up to 1,000 horsepower is now one of the leaders. The structural department has done some of the most important work in the states west of the Mississippi, and of mining structures it is the largest builder in the country. As contractors and builders of elevators, storage tanks and water towers, the company is one of the most extensive in the country. Other products manufactured by this company are gasoline farm tractors, transmission and conveying machinery, steel culverts and grain bins, coal and ash-handling machinery, and special machinery of all kinds. The plant of the company is worth a million and a half dollars, and additions are constantly being made to the equipment and output to an extent that promises for the Twin Cities of the future one of the largest industrial concerns in the country.

DATES AHEAD.

National Association of Cotton Manufacturers. Annual meeting, Boston, Mass., April 12 and 13.

Missouri Electric, Gas, Street Railway and Water Works Association. Annual meeting, St. Louis, Mo., April 13, 14 and 15.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

American Physical Society, Washington meeting, Washington, D. C., April 21 and 22.

Electrical Supply Jobbers' Association. Annual convention, Del Monte, Cal., April 25, 26 and 27.

American Institute of Electrical Engineers, Pacific Coast meeting, Los Angeles, Cal., April 25-28.

Southwestern Electrical and Gas Association. Annual convention, Houston, Tex., April 27-29.

Arkansas Association of Public Utility Operators' annual convention, Little Rock, Ark., May 3, 4 and 5.

American Foundrymen's Association, American Brass Founders' Association and the Associated Foundry Foremen. Annual Convention, Pittsburg, Pa., May 23-26.

National Electric Light Association. Annual convention, New York City, May 29 to June 3.

Commercial Section, National Electric Light Association, meeting and banquet, New York, N. Y., June 1.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

Association of Railway Telegraph Superintendents. Annual meeting, Boston, Mass., June 19-23.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Society for the Promotion of Engineering Education. Annual meeting, Pittsburg, Pa., June 26, 27 and 28.

Association of Railway Electrical Engineers. La Salle Hotel, Chicago, November 6-10.

Directory of Electrical and Allied Engineering and Scientific Societies

(Published in the second issue of each month.)

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RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) March 28, 1911.

987,686. HATCHING APPARATUS FOR EGGS.—Walter Bachmann, Langengrobsdorf, Germany. Filed March 17, 1910. A thermometrically actuated electromagnet controls the nearness of a vertically adjustable egg-chamber-carrying frame to the source of heat.

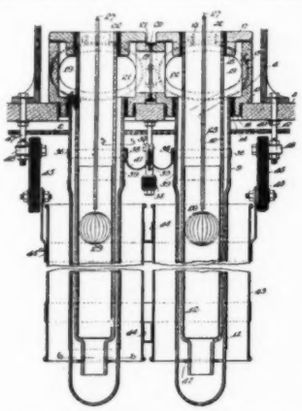
987,690. LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed April 11, 1907. Two sockets mounted horizontally end to end have a common tubular casing and common central contact. The casing is secured to a tubular supporting stem.

987,694. ELECTRIC HIGH-WATER ALARM. Edwin E. Brackett, Central Falls, R. I. Filed July 14, 1909. A floating ball swings a lever when rising so as to close an electric alarm circuit.

987,698. MULTIPLE-VOLTAGE CONTROLLER. Herbert W. Cheney, Milwaukee, Wis., assignor to Allis-Chalmers Company. Filed October 5, 1908. Has co-operating fixed and movable contacts arranged and connected so that all arc-producing interruptions of the armature circuit of the motor to be controlled occur at one fixed point.

987,715. MANUFACTURE OF STEEL. James H. Gray, New York, N. Y., assignor to Illinois Steel Company, Chicago, Ill. Filed February 16, 1909. Consists in treating molten metal in a Bessemer converter for the removal of silicon and carbon, transferring to an electric furnace in a ladle to which a separately formed basic slag has been added to remove phosphorus during transference, removing the exhausted slag from the ladle, and adding fresh basic slag to the metal after the transference to the electric furnace.

987,717. ELECTROLYTIC CELL. Thomas Griswold, Jr., Midland, Mich. Filed December 7, 1907. Comprises two solid, non-porous, carbon electrodes; an annular separating member between the electrodes, whereby a chamber for electrolyte is formed, the inner faces of the electrodes respectively forming an anode and a cathode; and a porous diaphragm separating the chamber into two compartments.



987,902.—APPARATUS FOR PRODUCING OZONE.

987,720. TELEGRAPHY. Benjamin P. Hayes, Topeka, Kans. Filed May 17, 1910. The line wire has two jack contacts into which the terminals of the local circuit can be plugged. In the local circuit is a relay, variable resistance and key.

987,725. PRINTING METER. Frank F. Kinney, Chicago, Ill., assignor to Minerallac Electric Company, Chicago, Ill. Filed August 6, 1908. A set of watt-hour meters, each having a printing attachment controlled by an electromagnet, has a common circuit for these magnets governed by a clock, so that the meter readings are printed periodically and simultaneously on all the meters.

987,768. ELECTRIC CLOCK. Lewis F. Stadel, Freeport, Mich. Filed August 4, 1909. An electromagnet is provided for tensioning the mainspring, the circuit of the magnet being periodically closed.

987,775. ELECTRICALLY-OPERATED CIRCUIT-BREAKER. Hermon L. Van Valkenburg, Norwood, O., assignor to Bullock Electric Manufacturing Company. Filed October 27, 1905. A circuit-breaker with a closing magnet and a tripping magnet has means including an auxiliary circuit-breaker for connecting the closing magnet to a source of current, and a tripping coil for the auxiliary breaker.

987,800. IGNITER. George Gray, Mianus, Conn., assignor to Mianus Motor Works, Mianus, Conn. Filed Jan. 21, 1910. One of a pair of electrodes is connected to a rock shaft.

987,810. SELF-OILING WHEEL. George H. Merwin, Milford, Conn. Filed December 29, 1909. A trolley wheel with a central oiling chamber.

987,845. APPARATUS FOR THE ELECTRICAL TREATMENT OF LIQUIDS AND SEMI-LIQUIDS. Virgil M. Wright, Cleveland, O. Filed January 13, 1910. A trough-shaped box is lined with aluminum and has a central carbon bar mounted on baffle bars and supporting inverted U-shaped aluminum electrodes.

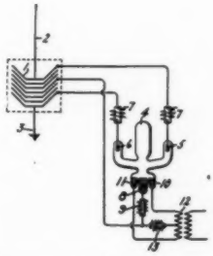
987,864. OPERATOR'S SELECTIVE RINGING-KEY OR SWITCH. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. Filed June 15, 1903. Consists of a number of plunger keys adapted to reciprocate through a top plate and engage contact springs.

987,874. SWITCHBOARD. Theodore A. Hammond, Passaic, N. J. Filed March 8, 1905. A spring jack for a switchboard.

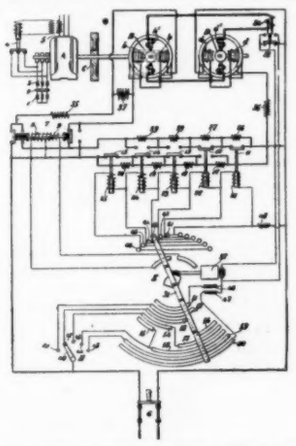
987,901. ELECTRIC FLATIRON. Francis H. McManus, Boston, Mass. Filed July 27, 1910. Has a chambered body containing two superposed heating elements wound on insulating plates on top of which is a switch for connecting in either heating element.

987,902. APPARATUS FOR PRODUCING OZONE. Clifford D. Meeker, East Orange, N. J., assignor to Gerard Ozone Process Co., New York, N. Y. Filed Aug. 4, 1910. Comprises a tank containing liquid insulation, and a cover of insulating material, ozonizing elements depending from the cover into the tank, and a casing above the cover and inclosing the upper ends of the elements.

987,924. RECTIFYING SYSTEM FOR ALUMINUM-CELL LIGHTNING-ARRESTERS. Charles P. Steinmetz, Schenectady, N. Y. assignor to General Electric Co. Filed Sept. 13, 1910. Combined with an electrolytic lightning arrester for an alternating-current system is a mercury-arc rectifier having its anodes connected to the terminals of the arrester and its cathode connected to an intermediate point in the arrester, and reactances interposed between the rectifier and the arrester.



987,924.—RECTIFIER FOR CHARGING LIGHTNING ARRESTER.



988,028.—MOTOR-CONTROL SYSTEM.

987,927. MACHINE-BRAKE. Clarence L. Taylor. Alliance, Ohio, assignor to Morgan Engineering Co., Alliance, O. Filed Feb. 21, 1908. A magnetic brake is mounted on the field frame of a motor.

987,947. ELECTROLYTICALLY REFINING ALLOYS. Anson Gardner Betts, Troy, N. Y. Filed April 19, 1909. Renewed Aug. 20, 1910. Consists of dissolving metals as anode by electrolysis in an electrolyte, depositing therefrom at a cathode an alloy, changing a condition of the solution and depositing a different alloy under the changed condition.

987,953. ELECTRIC FURNACE. John W. Brown, Lakewood, Ohio, assignor to National Carbon Co. Filed March 5, 1910. A furnace of the ring type having a series of sections.

987,956. TELEGRAPHIC TRANSMITTER. George A. Cardwell, New York, N. Y., assignor to American Telegraph Typewriter Co., New York, N. Y. Filed Jan. 15, 1908. Is provided with a keyboard similar to that of a typewriter.

987,979. ALTERNATING-CURRENT MOTOR AND CONTROLLING DEVICE THEREFOR. Vance I. Gray, Toledo, Ohio, assignor to F. Bissell Co., Toledo, Ohio. Filed April 13, 1908. Combined with the main windings are inductively balanced auxiliary windings parts of which may be cut out by a switch.

987,984. SWITCH. Gerald W. Hart, West Hartford, Conn., assignor to Hart Manufacturing Co., Hartford, Conn. Filed Feb. 21, 1910. An electromagnetically controlled snap switch.

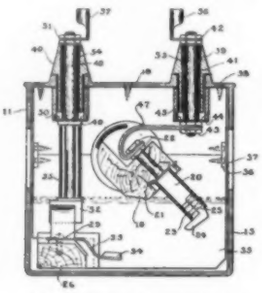
987,985. SWITCH. Gerald W. Hart, West Hartford, Conn., assignor to Hart Manufacturing Co., Hartford, Conn. Filed June 30, 1910. A rotary snap switch.

987,991. CONTACT-SHOE. Richard T. Jones and Frank T. Jones, Baltimore, Md. Filed Aug. 16, 1909. Has two pendant spring plates each having an electrical connection from one side of the same source of energy and the lower ends of said plates being movable. A contact plate is interposed between and independent of the pendant spring plates and normally connecting them electrically.

988,004. ANNUNCIATOR. Adam Lungen, New York, N. Y., assignor to Edwards & Co. Filed Oct. 13, 1909. An arm by which a number is carried is actuated by an electro magnet.

988,009. SIGNAL-TRANSMITTER. Judson McFell, Chicago, Ill. Filed Aug. 19, 1909. A motor is so arranged that it can operate a switch, a toothed actuator on the shaft being rotatable to selective position to vary a signal and axially movable to operative or inoperative relation to the switch. Means are provided for latching the actuator upon the shaft when in its operative plane, and for automatically restoring the actuator to its inoperative plane.

988,018. FLUSH-RECEPTACLE. William J. Newton, Lynbrook, N. Y., assignor to Metropolitan Switchboard Co. Filed June 26, 1909. A device adapted to be inserted in the box or casing of a wall switch in lieu of the usual switch mechanism and



988,245.—OIL SWITCH.

comprising a block having exterior spring blades adapted to establish electrical connections within the box, the block also having spring tongues within its interior and protuberances with channels extending toward the tongues and located to correspond to the usual operating buttons.

988,028. MOTOR-CONTROL SYSTEM. William H. Powell, Norwood, Ohio, assignor to Allis-Chalmers Co., and The Bullock Electric Manufacturing Co. Filed May 21, 1907. Comprises a separately excited motor, a separately excited generator exclusively supplying the armature thereof, means for controlling the electro-motive force of the generator, and a manually controlled rotary motor for operating the controlling means.

988,042. ELECTRIC METER. George E. Stevens, Lynn, Mass., assignor to General Electric Co. Filed Aug. 31, 1905. The tubular shaft has two contractions to one of which is affixed the commutator, and to the other a worm for operating the recording hands.

988,044. TELEPHONE-RECEIVER. Harve R. Stuart, Wheeling W. Va. Filed March 21, 1908. A number of radially arranged magnets are used.

988,093. SYSTEM FOR CONTROLLING ELECTRIC CIRCUITS. Gerald W. Hart, West Hartford, Conn., assignor to Hart Manufacturing Co., Hartford, Conn. Filed June 30, 1910. A pair of electric lines is provided with a number of branch circuits, each of which has a solenoid switch, all of which are put in parallel on a local circuit. Means are provided for cutting any of the solenoids out of the local circuit when its switch has been controlled thereby.

988,094. SWITCH. Gerald W. Hart, West Hartford, Conn., assignor to Hart Manufacturing Co., Hartford, Conn. Filed July 7, 1910. A push-button electrical switch for use with small currents.

988,104. SIGN. Ray G. Jenckes, Manaos, Brazil, assignor to Geneneral Electric Co. Filed June 25, 1910. A glass vessel filled with an electrolyte is made to act as a sign. One electrode consists of film-coated letters which become luminous upon the application of current to the terminals of the vessels.

988,148. MANUFACTURE OF FILAMENTS FOR INCANDESCENT LAMPS. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Co. Filed April 30, 1904. Consists in treating filaments for use in incandescent lamps with pentafluoride of iodine.

988,162. ELECTRIC SIGNALING MEANS. Andrew J. Allard, Richmond, Va., assignor of one-fourth to T. F. Green and one-fourth to David R. Creecy, Richmond, Va. Filed Oct. 29, 1910. A roller running on the side of the wheel flange is connected by a pivoted arm to a circuit controller so that an electric signal is given in case of a break in a wheel flange.

988,171. FIRE-ALARM SYSTEM. Hazel Burton Bush, Littleton, Colo. Filed May 25, 1909. A visible and an audible alarm are both operated by a system of solenoids.

988,192. ELECTRICAL TESTING DEVICE. Charles A. Hetherington, Des Moines, Iowa. Filed Dec. 20, 1909. A screw driver has in the interior of its handle a resistance coil provided with several terminals. A miniature lamp contained in the handle so as to be easily visible is illuminated when the screw-driver blade and a coil terminal are put in an electric circuit.

988,198. ALARM FOR INCUBATORS. Leonard H. Litscher, Dayton, Ore. Filed July 28, 1909. A moving arm operated by temperature changes closes an electric-bell circuit when the incubator becomes too warm or too cool for proper operation.

988,210. ART OF ELECTROLYTICALLY EXTRACTING METALS FROM THEIR ORES. William D. Rennie, Hackensack, N. J., assignor to Universal Ore Reduction Co., Phoenix, Ariz. Filed June 8, 1910. Consists in continuously causing a powder of an ore to ascend through an electrolyte by an applied force and to then allow it to descend under the action of gravity alone while subjected to the influence of an electrical current.

988,218. ELECTRICAL SIGNAL-RECORDING SYSTEM. Alfred L. Sohm, Whittier, Cal., assignor to Sohm Electric Signal & Recording Co., Los Angeles, Cal. Filed May 20, 1908. Renewed Feb. 23, 1910. A set of numbers from 0 to 9, affixed to a stamp, is operated by a number of electromagnets.

988,245. OIL-SWITCH. Herbert W. Cheney, Milwaukee, Wis., assignor to Allis-Chalmers Co. and Bullock Electric Manufacturing Co. Original application filed Oct. 22, 1906. Divided and this application filed April 19, 1909. One of the switch termals is connected to the binding post by a flexible connection, the other terminal moving in oil.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired April 3, 1911:

517,427. PROCESS OF MANUFACTURING ACTIVE MATERIAL FOR SECONDARY ELECTRIC BATTERIES. Wilhelm A. Boese, Berlin, Germany.

517,432 INCANDESCENT LAMP. Augustus C. Carey, Lake Pleasant, Mass.

517,445 COIN-CONTROLLED AND COIN-RETURN LOCK FOR TELEPHONES. Julius M. Dashiell, Jr., Washington, D. C.

517,450. ELECTRIC BURGLAR-ALARM. John Frame and Robert B. Morden, Cooper, Iowa.

517,455. SECONDARY CELL OR BATTERY. George B. Henry, Hartford, Conn.

517,498. ELECTRIC TRAIN-LIGHTING AND BRAKING SYSTEM. George W. Swartz, Florence, Ala.

517,502. CIRCUIT MAKER. Joseph Weaver, Canandaigua, N. Y.

517,531. INDUCTION ELECTRIC RAILWAY. Charles E. Roehl, St. Joseph, Mo.

517,549. CONDUIT ELECTRIC RAILWAY. Willie C. Keithly, San Francisco, Cal.

517,569. ADJUSTABLE DESK BRACKET FOR ELECTRIC LAMPS. Stephen G. Garlock and Bennie W. Marshall, St. Louis, Mo.

517,582. ELECTRIC SWITCH. Robb Mackie, New York, N. Y.

517,664. ELECTRICAL SWITCH. Ernest Ruebel, St. Louis, Mo.

517,668 and 517,669. ELECTRIC MOTOR. William J. Still, Toronto, Canada.

517,692. CONDUIT ELECTRIC RAILWAY. Herbert A. Goreham, Decatur, Ill.

517,714. GOVERNOR FOR ELECTRIC MOTORS. John F. Winter, Baltimore, Md.

517,743. ELECTRICALLY OPERATED RAILWAY-SWITCH. William S. Gavey, Brooklyn, N. Y.

517,762. TELEPHONE. Stewart D. McKelvey, Canton, Ohio.

517,763 and 517,764. MAGNETO-TELEPHONE. Stewart D. McKelvey, Canton, O.

517,770. RHEOSTAT. Alton J. Shaw, Muskegon, Mich.

517,773. ELECTRIC SWITCH. Charles F. Speed, Edward W. Barker and Charles P. Frank, Duluth, Minn.

517,778. ELECTRIC STOP-MOTION DRAWING-FRAME. Edmund Tweedale, Samuel Tweedale and Joseph Smalley, Castleton, England.

517,804. CONDUIT ELECTRIC RAILWAY. Wilton F. Jenkins, Richmond, Va.

517,812. SYSTEM FOR CONTROLLING ELECTRIC LIGHTS. William F. Bradner, Denver, Colo.